Electrical World

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Duty of the N. E. L. A. to the Public

Of the many subjects now receiving attention by members of the National Electric Light Association the most important is doubtless the relations between public service corporations and the public. The time has passed, if it ever existed, when a company could obtain a franchise through personal or political influence and then assume an attitude concerning its duty to the public of "take our service at our price under our conditions or leave it alone." To-day every thinking public utility operator knows that his interests are those of the public he serves and that the dividends of his company depend almost wholly upon the relations which exist between the company and the public. With agitators in many places clamoring for municipal ownership and operation of local utilities, politicians urging various State governments to develop water-powers within the borders of the State, and legislators discussing the acquisition of the railways at the capital by the federal government, it is evident that the attention of the public is being directed forcibly to the public utility business in general. Progressive central-station managers, and especially the members of the National Electric Light Association, know full well that the solution of the numerous problems now confronting the public and the utilities is to be found in the operation of the utilities by private companies under strict regulation by public service commissions. What many such managers have overlooked is the urgent necessity for having the facts involved properly presented to the public rather than given forth in distorted form by the agitators, politicians and interested legislators. In no way could the National Electric Light Association render better service to the country than by keeping the public fully informed concerning the proper conduct of the electric energy supply business under suitable public service commission control. Constructive suggestions to the public and the commissions should be the order of the day in the central-station business rather than counter attacks against ignorant agitators, unsafe politicians and unenlightened legislators.

Politics and Public Utilities

Perhaps the present time, when so much energy is devoted to the discussion of all kinds of reforms, political, social and economic, will prove to be opportune for the modest mention of one abuse which should be corrected. This is the manner in which a large proportion of the aldermen and other municipal officials in American cities yield to the pressure of their constituents in asking jobs from the public-utility companies. Of course, only a portion of the requests thus received by utility companies meet with a favorable response, although no doubt polite attention is given to all. However, the practice constitutes a nuisance, to characterize it by no harsher term. The merit system is becoming fairly well established in the public service, and it would seem that the next step should bring about the complete elimination of political spoils from the management of the affairs of public-service corporations. The need for this reform is greater, perhaps, than is generally realized by the public. It will require some degree of moral courage for managers of utilities to stiffen their backs against this insidious attack on efficiency; but no doubt many of the aldermen and other politicians would be secretly grateful if there was an absolute discontinuance of the practice of even occasionally honoring requests for appointment to jobs in privately owned public-service organizations for political reasons. In the states where public utility commissions exist it is probable that this evil will be gradually eliminated, and as it is likely that such commissions will be established in all states before long it is to be hoped that the time is not far distant when this annoying practice will become a thing of the past.

Westinghouse Business Last Year

The increase in sales billed by the Westinghouse Electric & Manufacturing Company during the fiscal year ended March 31, 1914, as compared with the previous year, was 9.4 per cent. This was not so large a gain as was shown by the 1913 fiscal year over 1912, 16.9 per cent. It is, however, a material change from the experience of 1912, when the gross sales billed were 10.3 per cent less than in 1911. Carrying the comparison back one year earlier, it is found that the gross sales in 1911 were 30.3 per cent greater than in the fiscal year 1910. These figures present wide fluctuations. The fluctuations, however, follow roughly those that were shown by another of the great electrical manufacturing concerns, the General Electric Company. The business of these two companies is so similar in nature that it is to be expected that they will be affected in about the same degree by changes in the general business situation. Manufacturing industries are always subject to greater fluctuation in volume of business and hence profit than public service industries and most other forms of business. As the industries upon which the electrical manufacturing companies depend for a market increase in stability of earnings, more stability should follow in the

manufacturing industries themselves. It is interesting to note that the net manufacturing profit of the Westinghouse company on the sales billed in the last fiscal year was 10.8 per cent of the gross. The annual report as a whole shows wholesome evidences of continued improvement in financial condition, substantial development in gross business and another step in the laying of a better foundation for the future.

Transformers for Changing Frequency

It is well known that when three transformers are connected in primary delta across the three mains of a three-phase supply system any triple-frequency harmonic in the excitation current of the individual primaries will circulate in the delta as a single-phase current of triple frequency. Mr. A. M. Taylor recently read a paper before the Birmingham Section of the British Institution of Electrical Engineers, as abstracted in our Digest, pointing out that, by allowing this triple-harmonic current to circulate through the primary windings of an extra transformer included in the delta, secondary currents taken from the latter will be of triple frequency and single phase. The secondary windings of the three main transformers may then be suppressed, leaving a transformer of four elements which raises the frequency to three times normal and changes the voltage in any desired ratio; so that a three-phase power-transmission system operating at twenty-five cycles per second may deliver single-phase lighting currents at seventy-five cycles per second. This plan may be regarded as adopting and fostering the third harmony. Theoretically, it is capable of being extended to the $3n$th harmonic; so that, as pointed out by Mr. Taylor, it may be possible to generate at 3666 cycles per second, and, by nursing the twenty-seventh harmonic, to throw aside the fundamental parent and utilize the foster-child of 99,000 cycles per second for radiotelegraphic purposes.

A disadvantage at present experienced with the method is that both the efficiency and power-factor of the triple-harmonic secondary system, as referred to the primary fundamental system, are low. That is to say, the forcing of the triple-value harmonic frequency entails an appreciable additional loss, and the magnetizing component of the primary current is also considerably increased. However, so far as radiotelegraphy is concerned, the advantage of a twenty-seven-fold frequency may well permit of accepting markedly low values of efficiency and power-factor.

It is interesting to notice that so far as concerns a simple three-phase circuit such triple-harmonic currents as are known to pulsate unchecked around closed delta connections of transformers are a mere by-product and rather an incubus than a blessing. The incubus becomes the foster-child when it is desired to establish triple-frequency transformation. The change of intent converts it into a blessing. It is an open question whether the efficiency and power-factor of the triple-harmonic nursery method can be raised sufficiently to make it practically serviceable on three-phase transmission systems. The method is, however, an important one to develop, especially in the direction of higher harmonics.

Adjustable-Speed Induction Motors

The ordinary polyphase induction motor with squirrel-cage secondary element behaves in regard to speed very much like the direct-current shunt motor. That is to say, it is essentially a single-speed machine. The single speed is synchronous speed, and the deviation of actual speed below this is a matter of a few per cent. Such a motor is ideal for driving constant-speed machinery but is un-ideal in the extreme for the very common duty of driving machinery at adjustable speeds over a considerable speed range. Various plans have been used for meeting this need. Induction motors with wound secondaries, closed on external adjustable rheostats, permit of a wide range of speed operation at a corresponding loss of efficiency. Multiple-pole groups in the primary winding also permit induction motors to operate at one of two or three speeds, but the plan has not been adopted very widely. In the article by Messrs. Hoeffleur and Misslin, on page 1247 in this issue, is described a method of adjustable-speed operation which has the advantage of maintaining a fairly high efficiency at all working speeds.

The secondary element of the three-phase induction motor described in the article is the rotor, as usual, but the primary element, instead of being a stator and receiving its currents from the line through fixed connections, is mounted on hollow ball-bearings and rotates, so that the machine has two rotors. The primary element receives its line currents through slip-rings of large diameter. Three slip-rings would be sufficient for one set of rotating poles, but, as the machine is arranged to operate with either two poles or four poles in the primary winding, six slip-rings are used. With the primary element at rest, this would permit running at either 1500 r.p.m. or 3000 r.p.m. with fifty-cycle, three-phase current. The primary element is, however, built within the squirrel-cage secondary of a second and auxiliary external induction motor, the primary element of which is a stator arranged to provide either six, eight, twelve or sixteen poles. This auxiliary three-phase motor can be run either forward or backward, thus changing the synchronous speed of the main or internal motor from 1000 to 2000 r.p.m. on the low main speed, or from 2500 to 3500 r.p.m. on the high main speed, and thus affording a total range from 1000 to 3500 r.p.m. in eighteen steps, with an efficiency, according to the curve sheets, of about 90 per cent in a motor delivering from 60 kw to 225 kw. It is hardly to be expected that the expense of telescoping two induction motors into one is likely to be justified for small machines. In the case of large machines, however, the importance of securing adjustability in

speed may occasionally warrant the added complexity of structure. The machine is certainly interesting in its behavior and construction.

The Philadelphia Electric System

As in the case of every large city, the electrical supply system of Philadelphia and its environs has been a gradual growth of separate systems consolidated finally into a single organization. As a result of this process of evolution the territory of the Philadelphia Electric Company, with 600 square miles of area to serve, presents characteristics peculiar to its history. At the present time the territory is divided into three general sections. Of these, the metropolitan district receives energy from the main stations, while the lines of the northern district, with a heavy railway load, and those of the territory around Chester, receive energy from auxiliary stations in the immediate vicinity. Besides the three generating plants there are thirty-four substations on the transmission system, and from these the output last year was more than 250,000,000 kw-hr.

From the engineering standpoint the main peculiarity of the Philadelphia system is attributable to the fact that it was equipped some years ago for two-phase distribution, and its underground feeder system has been developed with this particular arrangement in view. The two-phase system as such having now become pretty nearly obsolete, there has existed in Philadelphia the difficult problem of utilizing modern apparatus for the service of its old distributing system, in itself a very effective one and well adapted to its needs. Evidently a great two-phase network cannot readily be changed over for three-phase service, however desirable the latter may be for the transmission service and for long feeders.

Consequently the plant is extremely interesting in that use is made of three-phase-to-two-phase transformers on a very large scale, so that the old generating station, equipped in the main with two-phase turbo-generators, may work harmoniously and interchangeably with the station now under construction, in which will be installed standard three-phase turbo-generators. One of these, as recently described in our columns, is the largest unit of the kind ever constructed, having a full-load output rating of 35,000 kw. The prime mover is a thirteen-stage Curtis turbine, an important feature of the design of which is that it was planned for maximum steam efficiency at a little below full load so as to raise the average efficiency under working conditions. This is a sixty-cycle machine, while to meet the requirements for lower frequency which have been forced upon the supply company a twenty-five-cycle, 30,000-kw, three-phase turbo-generator will operate in the same station. From the new station will be controlled not only these two great units but three of the larger turbo-generator sets now operating in the present station, so that the output actually handled from the plant now built will rise to 119,000 kw—50,000 by sixty-cycle machinery, the rest by twenty-five-cycle units.

Part of the equipment enforced by the great railway load of the station has been an unusually extensive frequency-changing equipment. This is installed in a substation of its own, adjacent to the generating plant, and contains 9000 kw in two synchronous motor-generator sets converting from 6000 volts, sixty-cycle, two-phase, into 13,200 volts, twenty-five-cycle, three-phase, or vice versa. The twenty-five-cycle energy is transmitted to the substations of the Philadelphia Rapid Transit Company, and the station serves also as a reversible means of uniting the generating plants of the two frequencies. This element of differing frequency, always awkward, has appeared in more than one great plant, and the frequency changer has in such cases become a necessity. From the standpoint of the engineer even a more interesting substation is that which feeds energy to the direct-current lighting circuits. This is now operated by 6000-volt, sixty-cycle, two-phase energy, but presently will be shifted to 13,200-volt, sixty-cycle, three-phase, the change being accomplished by two-phase-to-three-phase transformers which feed energy to the synchronous converters for the direct-current service, the two-phase network, and the two-phase supply to the motor-generator sets for arc lighting.

A description of the details of the system would go too far into the minute matters fully discussed in the accompanying article, but throughout the whole runs evidence of great ingenuity in overcoming the difficulties imposed by the past history of the system and in making the somewhat intricate changes in the simplest and most certain manner possible. However, the arc-lighting station is worth some comment, as Philadelphia has the largest remaining equipment, and in fact the largest equipment which has ever existed, of open-arc lamps operated from Brush generators. The station devoted to this work contains thirty-eight motor-generator units, each consisting of a 150-hp, two-phase synchronous motor driving a pair of the largest size 9.6-amp Brush machines.

The importance of the railway load in this plant is another vital feature of its equipment. Nearly one-third of its output goes to traction service. Part of this is furnished at twenty-five cycles and a part is taken at sixty cycles for feeding energy to synchronous converters at this frequency. In addition, twenty-five-cycle, single-phase energy will be used at the rate of several thousand kilowatts for electric service on the Pennsylvania Railroad. Besides all this traction work, there is a particularly heavy motor load in large installations, in many cases requiring the installation of many substations with synchronous converters as well as the ordinary stationary transformers. With a total connected load rapidly approaching 200,000 kw, the system of the Philadelphia Electric Company is one of the greatest in the country.

The Electric Vehicle in Parcel-Post Service

With the anticipated constantly increasing use of parcel-post utilities and the attendant necessity for increased facilities, the government's problem will begin to assume proportions to demand new and radically different practices from those heretofore existing in postal operations. With the obligation which the present administration has assumed for the efficient and satisfactory conduct of this new departure, there is an immediate responsibility for determination in advance upon the ways and means of accomplishment under conditions which will become actualities within a very limited period. That the change taking place is an evolutionary one is indeed fortunate, as any revolutionary conditions would tend to defeat the project in its incipiency. While time is available there should be made an adequate scrutiny of the problems involved, and there should be competent concentration upon their solution. Wherever the government can secure the collaboration of such business genius as has successfully developed other kindred public utilities there should be no hesitation on its part to capitalize immediately the advantages thus presented.

Dependence upon past practices where a different characteristic of service has been rendered will be as futile in this case as it would be in any new commercial enterprise. The method by which the government has in the past secured vehicular service has been under severe question as to its justice, and in turn its severity upon the contractors has naturally resulted in a constantly decreasing efficiency of service, if not at the beginning of the contract period, certainly as the termination approaches. Dependence upon carrier service in the distribution of parcel-post material in large cities cannot be extended very much longer as the increasing human burden is not far from its ultimate maximum. These and other obvious deficiencies are what accentuate the belief that competent counsel alone can insure in advance the development of innovations to meet the new conditions.

The employment of mechanical transportation seems compulsory not only for the handling of the increasing load in transfer service between post office stations and to and from railway terminals but also as a necessary auxiliary to the carrier as a means of increasing his utility for distribution. As in commercial institutions, it will develop that the payroll factor would be the most expensive increase in the cost of operation, and therefore use must be made of means which will increase the radius of the carrier's personal activity. Horse vehicles would accomplish this in a limited way at a cost per unit about 50 per cent lower than that for machine service. The gasoline machine is uncalled for within the limited scope available to its capabilities, and its service, as indicated by the market price, is at least 25 per cent more expensive than that for the electric vehicle. The electric, as the cheapest, most economical and simplest vehicle that could be employed for the service required, will unquestionably be the ultimate choice. In co-operation with the Electric Vehicle Association of America, the public utility corporations furnishing electrical energy for lighting and motor service in every important city in the United States have offered their collective advice and counsel to the government officials responsible for parcel-post activity, and in taking advantage of this the government has excellent insurance of the success of its undertaking.

Objective Photometry

It is well known that the eye is an organ able to transmute a certain kind and portion of radiant power into physiological sensation. From the objective standpoint, the radiant power is merely a rate of displacement of alternating-current energy past a given normal small area, at an assigned point in space, at the rate of so many "abwatts" per square centimeter or ergs per second per square centimeter. Place the eye of a sufficiently sophisticated observer at the point, and the observer reports the sensation of light, assuming that the frequency falls within certain limits, and likewise that the power is within certain limits of intensity, neither too weak nor too strong. What is objectively power density is subjectively luminous flux density. By comparing sensations, the trained observer is able to measure inferentially the luminous flux density at the point of space in question. Owing to the limitation in the precision of comparing optical sensations, the precision of subjective photometry is much less than that which should correspond to objective photometry, if a sufficiently sensitive radiant-power-density measuring instrument could be used instead of the eye.

An interesting paper read recently by Herr Voege before the German Illuminating Engineering Society in Berlin, and reported in the *Elektrotechnische Zeitschrift*, deals with a novel method of attempting objective photometry. Heretofore bolometers and thermoelectric cells have been used, with galvanometers, to measure the incident radiant power, but with only a limited degree of success. Herr Voege describes the use of an Elster-Geitel photoelectric cell as the artificial eye. When an argon-filled glass chamber is equipped with a central platinum wire anode and a cathode layer, of metallic sodium or potassium, on one inside wall, this layer becomes a photoelectrically sensitive surface, when an emf of, say, 100 volts from a small storage battery is impressed upon the anode and cathode of the chamber. High-frequency radiant energy, incident on the chamber, causes electrons to be emitted from the alkali, which are caught by the platinum anode and produce a feeble but readily measurable current in the battery circuit. It is stated that this current is directly proportional to the radiant power density within a very wide range. The cell, like a photographic plate, is most sensitive to violet light and least sensitive to red light; so that in its uncorrected natural state it is able to compare the luminous intensities of two lamps only when hav-

ing the same color or spectrum distribution. However, Herr Voege reports that he has been able to find tinted light filters, both of liquid and solid form, which, placed in front of the cell, serve to weaken its response to the blue end of the spectrum and raise its response to the red end; so that the shielded cell develops its maximum sensitiveness near wave-length 0.55 μ as does the normal human eye. The curve of the cell's sensibility does not fall off on each side like that of the eye, but sufficiently nearly so for many photometric purposes.

In order to photometer a test lamp, the galvanometer-scale is suitably marked off into "candles," and a standard lamp of known candle-power inside a special reflector, is then brought within such a distance of the shielded cell that the galvanometer indicates the correct candle-power. The reflector and socket are now fixed and the standard lamp replaced by the test lamp. The new galvanometer reading measures the required candle-power. The incandescent lamp is brought up to within about half a meter from the shielded cell, so that the sensitiveness of the latter is not yet all that might be desired. However, it is greatly to be hoped that the new photo-electric cell device may be developed, at the hands of photometrists, into a thoroughly practical instrument.

The Great Southern Transmission Network

It will be startling news to some of our readers that there has quietly grown up in the South what is to-day by far the most extensive interconnected transmission system in the world. That splendid work was being done in the development of the water-powers of the southern Appalachian country has been already made evident, but the linkage of the various networks into what now approximates, and one day will become, a united whole is a comparatively new phase of the situation. Gradually in the South transmission enterprises grew and flourished until there are now seven great systems with a wide ramification of transmission and distribution lines. Of these, six, covering the States of North Carolina, South Carolina, northern Georgia and a large part of Tennessee, are now actually in physical connection through various traffic arrangements.

If the feat were desirable, one could operate a motor in Nashville, Tenn., by energy generated at Rockingham, N. C., over a circuit roughly 1000 miles long. Some day in the near future perhaps it will actually be done, if only as a unique accomplishment in long-distance transmission. The energy would first pass over the lines of the Carolina Power & Light Company at 100,000 volts to a point near Raleigh. Then it would turn westward and pass upon the lines of the Southern Power Company and follow them southwest at the same voltage until it reached the great generating plant at Tallulah Falls. Then it would pass on with unlowered voltage to Atlanta over the lines of the Georgia Railway & Power Company, and thence over another branch of the same system northward to the Tennessee boundary, where it would join the lines of the Tennessee Power Company and be passed on at 66,000 volts to Nashville. A little later, when the line between Nashville and Memphis is completed, the western terminus of the line carrying energy derived from the Cape Fear River, which runs into the Atlantic, would lie on the banks of the Mississippi.

The independent networks have naturally touched elbows and then joined hands. Operating at first in sections quite independent of each other, they have gradually spread out and worked together until actual interchange of energy has become the most natural thing in the world. The main point of the matter is not what has been done but what may be done. At present the local interchange of energy is a mere convenience; the connection exists, but it is not yet ready to be utilized in full. In the first place, the system of the Alabama Power Company will spread out and be connected with those of its neighbors, and then some far-sighted captain of industry must grasp the situation and make the most of it. To-day there are seven neighboring systems, covering five States. They are in a condition comparable with an equal number of large suburban towns in each of which has grown up its own electrical system along various lines of engineering and finance. The task before the great organizer is to unite the systems of the towns or the States into a coherent network capable of gaining all the advantages that lie in such union and of giving better and more extensive service than is possible with the present loose connection of the plants.

A glance at the map tells the story. A few hundred miles of tie line would provide main feeders from Tallulah Falls to Parksville, give an independent connection by way of Augusta between the systems of the Southern Power Company and the Georgia Power Company, and would tie in the lines of the Alabama Power Company at two points, one by way of the Georgia Power Company's lines and the other northward by the Tennessee Power Company system. This plan unites two watersheds, that of the Mississippi Valley and that of the Atlantic, giving all the advantages that come from what one may call the diversity-factor of flow. It would not make much difference at first whether there were actual financial union or not. The main thing is complete interconnection and friendly traffic relations whereby each plant on the system could be utilized to its greatest advantage and the waste of water that takes place through disconnected hydraulic effort could be averted. As a final engineering step, with the energy of five States behind the work, it ought to be possible to block up one of the gorges in the mountains and construct an artificial lake large enough to tide over the dry season and utilize the prodigious rainfall of the southern Appalachians. The country is without natural lakes but there are few districts where natural facilities for impounding the flow could be more easily or cheaply obtained. The work already done brings to view a project of tremendous possibilities.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

Detroit Convention of the A. I. E. E.

At the thirty-first annual convention of the American Institute of Electrical Engineers, to be held at Detroit, Mich., from June 22 to 26, the following papers will be presented: "Electric Heating as Applied to Marine Work," by Mr. C. S. McDowell; "The Electrically Driven Gyroscope in Marine Work," by Mr. H. C. Ford; "Direct-Current Motors for Coal and Ore Bridges," by Mr. R. H. McLain; "Method of Keeping Down Peaks on Power Purchased on the Peak Basis," by Mr. T. E. Tynes; "Concatenated Induction Motors for Rolling-Mill Drive," by Mr. William Oschmann; "The Sphere-Gap as Means of Measuring High Voltage," by Mr. F. W. Peek, Jr.; "The Electric Strength of Air," by Messrs. J. B. Whitehead and W. S. Gorton; "Sphere-Gap Discharge Voltages at High Frequencies," by Mr. J. C. Clark and Prof. H. J. Ryan; "Data on High-Tension Transmission Systems," by Mr. Percy H. Thomas, chairman of the engineering data committee; report of the engineering data committee on specifications for high-tension insulators; "Prime Movers," by Messrs. H. G. Stott, W. S. Gorsuch and R. J. S. Pigott; "Voltage Testing of Cables," by Messrs. W. I. Middleton and Chester L. Dawes; "Sterilization of Water by Ultra-Violet Rays," by Mr. M. von Recklinghausen; "Toll Telephone Traffic," by Mr. Frank F. Fowle, and "A High-Speed Printing Telegraph System," by Mr. Carl Kinsley.

On Thursday evening there will take place the presentation of the Edison medal and past-presidents' badges, and President-elect P. M. Lincoln will be introduced. Numerous entertainment features have been arranged for.

Electrical Characteristics of Mexico

Mr. T. D. Smith, of the Willard Storage Battery Company, who spent five years in Mexico, gave an interesting talk, with humorous interludes, relating to the electrical situation in Mexico in addressing the Chicago Jovian League on May 11. Mr. Perry R. Boole presided. Mr. Smith said that when finally the situation in Mexico is cleared up that country will present an immense field for electrical development. Already there are hydroelectric developments of considerable size, the total rating being about 130,000 kw. The frequency used is usually sixty cycles, although the Mexican Light & Power Company, of Mexico City, uses fifty cycles. The greatest demand for electrical energy is in the silver-mining region of the State of Hidalgo. There should be an excellent demand for electric-heating apparatus in a few years. Interior wiring is done largely by the use of lamp cord and is rather primitive. However, some good American-made insulated wire is in place in several of the mines. Many of the electrical fittings imported from continental Europe are of cheap and flimsy construction. According to Mr. Smith's information, there are only two electrical installations in Mexico that meet the requirements of the National Electrical Code.

Arrangements Complete for Philadelphia Convention of National Electric Light Association

All arrangements have been completed for the convention of the National Electric Light Association to be held at the Bellevue-Stratford Hotel, Philadelphia, next week. Meeting rooms large enough to accommodate all who may wish to attend any of the sessions have been secured within the hotel, and inasmuch as there will be three simultaneous sessions during some of the days, the bulletin system of announcing at each session what is going on in other sessions will again be used. On the roof garden of the hotel, exhibits of Class D members will be tastefully arranged, although much of the exhibition space will be used by the exhibitors merely for reception purposes. No change has been made in the special trains from the Pacific Coast, Middle West, Southeast and Pittsburgh, and the officers of the association predict a record-breaking attendance and a most successful meeting. The Philadelphia Electric Company, which will act as the host for the convention, has provided abundant entertainment features for such times as the delegates and guests will not be actually engaged in convention work. The complete program of the convention follows:

General, Executive and Public Policy Sessions

Tuesday, June 2, 10 a. m.

(1) Welcome to the city. (2) Address of President McCall. (3) Announcements. (4) Report of committee on organization of the industry, by Mr. Holton H. Scott. (5) Report of secretary, by Mr. T. C. Martin. (6) Report of insurance expert, by Mr. W. H. Blood, Jr. (7) Report of committee on progress, by Mr. T. C. Martin. (8) Report on the "Question Box," by Mr. S. A. Sewall. (9) Paper, "Safety First," by Mr. Paul Lupke.

Wednesday, June 3, 8 p. m.

(1) Action on report of public policy committee, presented by Mr. Arthur Williams. (2) Presentation of proposed constitutional amendments, by Mr. F. W. Frueauff. (3) Report of treasurer, by Mr. W. F. Wells. (4) Election of nominating committee. (5) Appointment of committee on resolutions. Music.

Wednesday, June 3, 8.45 p. m.

Public Policy Session: (1) Reading of report of public policy committee. (2) Address. (3) Exercises in celebration of the first American Electrical Exhibition and first International Electrical Congress, in Philadelphia, 1884. (4) Music.

Friday, June 5, 10 a. m.

(1) Report of committee on award of Doherty medal. (2) Address, "The Definite Plans of the Society for Electrical Development," by Mr. J. M. Wakeman. (3) Symposium, relations with geographical sections. (4) Report of committee on memorials, by Mr. T. C. Martin. (5) Report of committee on constitutional amendments, by Mr. F. W. Frueauff. (6) Vote on constitutional amendments. (7) Report of committee on resolutions. (8) Report of nominating committee. (9) Election of officers. (10) Adjournment.

Technical Sessions

Tuesday, June 2, 2.30 p. m.

(1) Report of committee on meters, by Mr. P. H. Bartlett. (2) Report of committee on grounding secondaries, by Mr. W. H. Blood, Jr. (3) Report of committee on electric measurements, by Dr. A. E. Kennelly. (4) Foreword, "The Greater Electric Vehicle Problems," by Mr. W. P. Kennedy. (5) Address, "The Electric Vehicle," by Dr. C. P. Steinmetz.

Wednesday, June 3, 10 a. m.

(1) Report of committee on electrical apparatus, by Mr. L. L. Elden. (2) Paper, "Temperature and Its Relation to the Limiting Capacity of Electrical Apparatus," by Mr. F. D. Newbury. (3) Report of committee on underground construction, by Mr. P. Torchio. (4) Report of committee on overhead line construction, by Mr. Thomas Sproule.

Thursday, June 4, 2.30 p. m.

(1) Report of committee on prime movers: (a) steam, by Mr. I. E. Moultrop; (b) hydraulic, by Mr. J. F. Vaughan. (2) Paper, "Selection of Hydraulic Turbines," by Mr. Charles V. Seastone. (3) Report of committee on street lighting, by Mr. J. W. Lieb. (4) Report of committee on accident prevention, by Mr. M. J. Insull.

Commercial Sessions

Tuesday, June 2, 2.30 p. m.

(1) Address of the chairman of the section, by Mr. T. I. Jones. (2) Report of finance committee, by Mr. E. L. Callahan. (3) Report of membership committee, by Mr. J. F. Becker. (4) Report of publications committee, by Mr. Douglass Burnett. (5) Report of committee on education, by Mr. F. C. Henderschott.

Wednesday, June 3, 10 a. m.

(1) Report of committee on rate research, by Mr. E. W. Lloyd. (2) Address. (3) Report of lamp committee, by Mr. F. W. Smith.

Thursday, June 4, 10 a. m.

(1) Report of committee on non-peak and high-load-factor business, by Mr. G. H. Jones. (2) Address, "Age of Co-operation," by Mr. Elbert Hubbard. (3) Report of committee on interurban lighting of highways, by Mr. G. B. Tripp.

Thursday, June 4, 2.30 p. m.

(1) Report of committee on wiring of existing buildings, by Mr. R. S. Hale. (2) Report of committee on electrical merchandising and advertising, by Mr. Parker H. Kemble. (3) Report of nomination committee. (4) Election of officers.

Hydroelectric Sessions

Thursday, June 4, 10 a. m.

(1) Address of chairman of section, by Mr. W. W. Freeman. (2) Report of committee on hydro-progress, by Mr. T. C. Martin. (3) Paper, "The Nature of Electrical Disturbances in Transmission Work," by Mr. D. B. Rushmore. (4) Paper, "The Transmission Systems of the World Operating at and Above 70,000 Volts," by Mr. Selby Haar. (5) Report on permanent methods of measuring water in water-power plants, by Mr. D. W. Mead. (6) Paper, "Water-Power Plant Economics," by Mr. O. B. Coldwell. (7) Illustrated address, "Hydroelectric Work in California," by Mr. John A. Britton.

Thursday, June 4, 2.30 p. m.

Second hydroelectric session held in conjunction with third technical session.

Accounting Sessions

Tuesday, June 2, 2.30 p. m.

(1) Address of the chairman of section, by Mr. H. M. Edwards. (2) Report of library committee, by Mr. C. L. Campbell. (3) Report of "Question Box" committee, by Mr. E. C. Scobell. (4) Paper, "Cost and Statistics," by Mr. T. J. Walsh.

Wednesday, June 3, 10 a. m.

(1) Report of committee on uniform system of accounts, by Mr. J. L. Bailey. (2) Address, "Appraisals," by Dr. D. C. Jackson. (3) Paper, "Variation in Public Service Systems of Accounting," by Mr. E. C. Scobell.

Thursday, June 4, 10 a. m.

(1) Paper, "Accounting for Merchandise Sales," by Mr. H. B. Lohmeyer. (2) Paper, "Suspense Accounts," by Mr. Fred Schmitt. (3) Paper, "Mechanical Sorting and Tabulating Systems," (a) in connection with disbursement accounts, by Mr. F. A. Birch; (b) as applied to inventory of transmission and distribution systems, by Messrs. G. L. Knight and C. V. Woolsey. (5) Paper, "Purchasing, Storing and Accounting of Coal for the New York Edison Company," by Mr. C. R. Lehmann.

Electric Vehicles for Parcel-Post Service

At the meeting of the New York Section of the Electric Vehicle Association of America, May 22, Mr. F. W. Frueauff, chairman of the N. E. L. A. committee on parcel-post co-operation, and Mr. J. H. McGraw, chairman of the committee on parcel-post delivery for the Electric Vehicle Association of America, discussed the work of their respective committees.

When it was suggested, Mr. Frueauff said, that the National Electric Light Association co-operate in the movement to further the use of electric vehicles in parcel-post service, the central-station men were glad of the opportunity to participate. Mr. Frueauff said that his committee had sent letters to 1100 manufacturers, including every central station in the United States in a city with a population of more than 10,000, appealing to their self-interest and urging them to instil into the minds of their Congressional representatives and postal officials the advantages of the electric vehicle.

The committee has not attempted to influence the authorities, he stated, as to how the government shall handle its parcel-post delivery; for that is a matter that the post office alone can determine, but the committee is trying to point out that the use of the electric vehicle for this delivery is the best solution of the problem.

Speaking of the work of the committee on parcel-post delivery, Mr. McGraw said that the number of electric vehicles which could be used in the parcel-post service, if there were the proper disposition and facilities for employing them, may be estimated from the number of parcels now being handled in fifty of the principal cities. There will be at least 600,000,000 parcels handled annually in these cities, or 2,000,000 a day, and assuming that an electric vehicle can handle an average of 200 packages a day, it would require a total of 10,000 vehicles, or an average of 200 machines in each of these cities, to handle the parcels. This, he said, is business worth securing for manufacturers and would bring the central stations in each of the cities an average income of $100 a day, or a total of $1,500,000 annually, assuming an energy consumption of 12.5 kw-hr. daily per vehicle. These figures are not at all surprising when it is considered that the public is buying postage stamps for parcel-post service at the rate of about $25,000,000 per annum. Chicago alone spends $4,000,000 and New

York comes next with $3,000,000 annually. Collection and delivery are said to represent 90 per cent of the traffic in parcel-post transportation; therefore an estimate of 5 per cent of the receipts as the cost of electricity is not unreasonable.

Following the remarks of Mr. Frueauff and Mr. McGraw, Mr. W. P. Kennedy abstracted briefly a paper entitled "The Electric Vehicle in Parcel Post Service for Economy and Reliability," prepared with the idea of educating government officials and others regarding the advantages of the electric vehicle for the delivery of parcels. Mr. Kennedy stated that the representatives in Washington had asked for more operating data, and the committee is now gathering the information desired.

Mr. George Duck, president of the New York Motor Truck Club, declared that the work of the association would be well directed if influence were exerted upon the government to allow the contractors who handle the parcel-post delivery in the various cities fairer compensation for their services. Under existing conditions some of these contractors are just able to cover expenses, while in other instances actual losses have been sustained.

Mr. J. V. Lupo recited some of his experiences in transporting mail in Newark, N. J., and declared that the four-year period usually stipulated is too short for the proper development of an efficient delivery system. He also concurred in the belief of Mr. Duck regarding the inadequacy of the compensation received from the government, and maintained that with the wages now prevalent it is almost impossible to obtain experienced and trustworthy workmen. Mr. Lupo favors the electric vehicle.

Mr. R. L. Lloyd, of Philadelphia, also took part in the discussion.

Growth of the Central-Station Industry in the Central States

Data received from central-station companies in some of the Central States make it possible to estimate fairly closely the present rate of growth of the business in that section of the country. The East North Central group includes Ohio, Michigan, Indiana, Wisconsin and Illinois, and for the first four of these States the available data for March are thoroughly representative. They include figures from the companies operating in sixteen cities of over 50,000 population, which between them generated in March, 1913, over 70 per cent of all the energy produced in those four States. The results are given in Table I.

TABLE I—CENTRAL-STATION DATA FOR FOUR EAST NORTH CENTRAL STATES

	Gross Income from the Sale of Electricity for All Loads			Total Energy Output in Kilowatt-hours of All Stations Subsidiary to the Companies Reporting		
	March, 1914	March, 1913	Per Cent Increase	March, 1914	March, 1913	Per Cent Increase
Ohio	$1,194,618	$1,050,444	13.7	47,599,760	38,883,865	22.5
Michigan	791,049	692,085	14.3	39,639,857	35,681,368	11.0
Wisconsin and Indiana	353,829	326,137	8.5	31,935,583	29,905,643	6.8
Total	$2,339,496	$2,068,666	13.2	119,175,200	104,470,876	14.1

On the basis of output it may be estimated that the Michigan companies included above generate about 62 per cent of all the energy produced in the State, while those of Wisconsin and Indiana are scarcely less representative. For Ohio it may be assumed that more than 90 per cent of the industry is represented, as the returns from this State include the companies operating in Cleveland, Cincinnati, Columbus, Toledo, Dayton, Youngstown, Akron, Springfield and Canton. From the 1912 census figures it is possible to estimate quite closely that in March, 1913, all the central-station companies in the States of Ohio, Michigan, Wisconsin and Indiana sold about 144,243,000 kw-hr. of energy, for which they received a gross income of $3,651,200; and, since the annual expansion-factor of 13.2 for revenue and 14.1 for output obtained by the *Electrical World* may safely be regarded as representative for the whole section, it is possible to compute that, for these four States, gross income increased from $3,651,000 in March, 1913, to $4,125,000 in March, 1914, while energy output increased in the same time from 144,243,000 kw-hr. to 164,700,000 kw-hr. Illinois is the fifth State included in the East North Central group. While authentic data from the properties in that State are not sufficiently numerous to provide an exact index to the rate of their growth, it is thought that the characteristic here is the same as that officially obtained for Ohio and Michigan. On that assumption Table II for the East North Central belt can be presented.

TABLE II—CENTRAL-STATION DATA FOR EAST NORTH CENTRAL BELT

	Gross Income from Sale of Energy		Total Output in Kilowatt-hours	
	March, 1914	March, 1913	March, 1914	March, 1913
Sixteen companies in Ohio, Michigan, Indiana and Wisconsin	$2,339,496	$2,068,666	119,175,200	104,470,876
All central stations in above four States (est.)	4,125,000	3,651,200	164,700,000	144,243,000
All central stations in the East North Central group (est.)	7,340,000	6,492,900	306,000,000	268,163,000

Those who are searching for silver linings to the clouds of business depression should take careful note of the fact that at the present rate of growth (which is in excess of 13 per cent) the central stations in the East North Central States will show a gross income of over $80,000,000 for the year 1914—more than $10,000,000 above the 1913 figures.

Data received from the remainder of the Central States have not been quite so representative as those of the East North Central group, but some idea of the rate of progress in these States may nevertheless be obtained. Within the West North Central group may be included Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska and Kansas. The *Electrical World* has received data for March from many of the major cities in the district named, including St. Louis and St. Joseph, Mo.; Duluth and St. Paul, Minn.; Des Moines, Davenport and Sioux City, Ia., and Omaha and Lincoln, Neb. The rate of growth for the industry in this territory is found to be somewhat more than 25 per cent both on energy output and on gross income. Much of this fine showing is due, however, to the wonderful expansion in business of the St. Louis companies. If the figures for this city are omitted, the resulting coefficient will probably more truly represent the rate of electrical expansion in the West North Central belt. It may be estimated, then, that the urban supply systems in this territory are increasing their output at a rate of 12 per cent per year, for which they are realizing an increase in gross income of from

9 to 10 per cent. It may be of interest to note that the combined output of all the central stations of the West North Central group for March, 1913, was in the neighborhood of 69,000,000 kw-hr., and the gross income from the sale of energy some $2,750,000. For March of this year the figures are probably 77,500,000 kw-hr. and somewhat more than $3,000,000.

In the East South Central group may be included Kentucky, Alabama, Mississippi and Tennessee. Authentic data received from companies in these States cover an output of energy which is little less than one-half of the entire output of the group. Aggregates show that $218,003 of gross income in March, 1913, increased at a rate of 14 per cent to $248,345 in March, 1914, and the energy output of stations from 10,837,745 kw-hr. at a rate of 10.1 per cent to 11,924,325 kw-hr. This shows a healthy rate of expansion which is not greatly less than that established by the last census for the period 1907-1912. For the entire central-station industry in these four States it may be calculated that gross income grew from $705,830 in March, 1913, to $789,000 in March, 1914, and energy output from 22,460,000 kw-hr. to 24,700,000 kw-hr. All available figures from the West South Central States (including Louisiana, Arkansas, Oklahoma and Texas) are in marked contrast with the above flattering returns and indicate a slower rate of expansion in this section of the country for March than in any other of which the *Electrical World* has record. The summary of gross earnings published by the Stone & Webster Management Association for its four principal Texas subsidiaries shows an increase for March, 1914, over March, 1913, of less than 4 per cent; and these companies between them probably handle over 60 per cent of the entire energy output of the State. For Louisiana and Arkansas the returns are a little more favorable, but the available figures for the whole group show only 4.8 per cent increase on gross income and 6.2 per cent on energy output. On a basis of output, these returns cover some 70 per cent of the entire industry of the four States. It may be estimated that for all the central stations in the group the gross income increased from $1,151,700 in March, 1913, to $1,206,000 in March, 1914, and the energy output from 31,542,000 kw-hr. to 33,500,000 kw-hr.

Summarizing the foregoing results, it may be said that the condition of the electrical business in the Central States for March of this year as compared with March of last year is shown fairly accurately by the following rates of increase: East North Central, gross income 13.2, energy output 14.1; West North Central, 9.0 and 12.0; East South Central, 14.0 and 10.1; West South Central, 4.8 and 6.2.

TABLE III—CENTRAL-STATION DATA FOR FOUR GROUPS OF CENTRAL STATES (ESTIMATED)

	Gross Income			Energy Output in Kilowatt-hours		
	March, 1914	March, 1913	Per Cent Rate of Increase	March 1914	March, 1913	Per Cent Rate of Increase
East North Central.	$7,340,000	$6,492,900	13.2	306,000,000	268,163,000	14.1
West North Central.	3,030,000	2,783,000	9.0	77,500,000	69,420,000	12.0
East South Central.	798,000	705,830	14.0	24,700,000	22,460,000	10.1
West South Central.	1,206,000	1,151,700	4.8	33,500,000	31,542,000	6.2
Total.....	12,374,000	$11,133,430	11.2	441,700,000	391,585,000	12.8

Estimated figures for gross income and energy output of all central stations operating in these four groups of Central States will be found in Table III.

It may be remembered that in the *Electrical World* for May 16 a figure of 314,500,000 kw-hr. was given as the probable energy output for March of all the central stations in the Middle Atlantic States (New York, New Jersey and Pennsylvania). Since the March output of the entire country was only 1,240,000,000 kw-hr., it is easy to see that the Middle Atlantic and the East North Central States between them are responsible for about one-half of all the energy generated by the central stations of the United States.

Electric-Vehicle Interests Convene at Boston

The second annual convention of electric-vehicle and central-station interests in New England was held at the Engineers' Club, Boston, Mass., on May 19 and 20. The marketing of the electric vehicle was considered from many angles, and the discussions were among the most prolific of those taking place in any convention of electrical interest in Boston in recent years.

Terminal Freight Congestion

On the evening of May 18 Mr. Fred A. Hortter, car accountant of the Boston & Maine Railroad, read a paper before the New England Section of the Electric Vehicle Association of America in which he set forth the poor load-factor of the city trucking service as at present conducted, discussed the causes of congestion in freight handling, and advocated the organization of a centralized scheme of merchandise transportation to and from railroad terminals as the solution of the problem of rapid and efficient service. The author contended that the use of individual motor trucks represents an improvement in the tools of transportation, but that an organized service must be given before the present troubles of the railroad and the shipper over incoming and outgoing freight will be eliminated. The discussion centered mainly upon the transportation side of the problem, without much reference to electric trucks.

The Electric Vehicle Advancing in Massachusetts

In a brief address of welcome at the opening of the convention President Day Baker of the Electric Motor Car Club, Boston, said that the rate of electric vehicle registration exceeded that of the gasoline cars in Massachusetts in 1913 and that 1000 trucks and passenger cars are now in service in the State. Eighteen makes of commercial and pleasure electric vehicles are now represented in Boston. Conditions in the trade are encouraging, and the public is surely coming to appreciate the attainments of this form of transportation.

Co-operation

Past-president W. H. Blood, Jr., of the Electric Vehicle Association of America, congratulated that body upon the active spirit of its membership and spoke in high terms of the part the manufacturers, central stations, vehicle owners and the technical and lay press are playing in the development of the industry. He paid a well-deserved tribute to the enterprise of the Edison Electric Illuminating Company of Boston in the exploitation of the electric vehicle in New England and in the elimination of its own horse-drawn equipment in favor of "electrics." Favorable rates for charging energy have also been made by the company. Closing, the speaker touched upon the financial interests behind the electric vehicle, considering central stations and allied enterprises, whose investment totaled $500,000,000 recently.

Discussion

A long discussion followed the opening address, the

participants being Messrs. D. C. Tiffany, Ohio Electric Car Company, Boston; Converse D. Marsh, Bates Advertising Company, New York; Charles B. Burleigh, General Electric Company, Boston; Col. E. W. M. Bailey, S. R. Bailey & Company, Boston; Day Baker, General Vehicle Company, Cambridge, Mass.; Albert Weatherby, Detroit Electric Motor Car Company, Boston; David W. Beaman, New Bedford Gas & Edison Light Company, New Bedford, Mass.; W. M. Thayer, Hartford (Conn.) Electric Light Company, and S. Fred Smith, Salem (Mass.) Electric Lighting Company. Emphasis was laid upon the need of more co-operation among the smaller central stations in furnishing battery-charging facilities at reasonable rates. A 25-cent rate per kw-hr. at Manchester, Mass., was cited as an insuperable obstacle to a vehicle sale by one of the speakers. Mr. J. S. Codman, S. R. Bailey & Company, Boston, said that this rate was in a measure due to the peculiar situation of the company, which is maintained at a loss by wealthy summer residents and which generates no electricity. He admitted that the price was inordinate and expressed the hope that it might be reduced as a result of the electric-vehicle movement. Another speaker made the point that professional electrical engineers in many cases view the electric vehicle as a toy and do not realize its immense development in the last three or four years. Praise was accorded the Stone & Webster and Tenney companies for their co-operation. Mr. Burleigh urged continual effort to make the small central station realize the value of off-peak charging service, which covers 99 per cent of the battery requirements. Colonel Bailey cited the willingness of central stations to furnish him with charging facilities on his tours around the eastern portion of the country, saying that in Ashtabula, Ohio, a 1200-kw generator was run by the courtesy of the local company to enable an exciter to yield the required service. Colonel Bailey contended that charging should be a simple matter to arrange by use of the exciter bus and emphasized the effectiveness of a boost at a high rate when touring.

Mr. Beaman briefly described a new 60-ft. by 100-ft. garage erected by the New Bedford company to house thirty electric cars, the notable feature being a front of Indiana limestone, used because the structure adjoins the company's office building. Nine "electrics" are used by the company itself to-day. Mr. Thayer outlined the famous battery-exchange-service system in use at Hartford, which has been fully described in the *Electrical World*. There are now fifty-six trucks in service and on order, and the weekly revenue of the company from the battery-exchange service is about $200. The daily mileage, upon which rates are based, is now 1600 and will soon be 2000. The company expended only about $200 in fitting up its charging station, aside from the battery investment, jacks representing this outlay. The labor item is the most important element of expense. Last winter's experience indicated that an average of one and one-half batteries per truck must be carried to give suitable service, this number falling to one and one-third with vehicle charging at night, assuming that the battery is kept on board. With increased business this margin can be cut down.

The Electric Vehicle Association of America

Mr. A. Jackson Marshall, executive secretary of the E. V. A., said that 700 members are now on the list, compared with 400 last fall, and a total of 1000 is anticipated by the Philadelphia convention in October. The growth of geographical sections, of which there are now six, has spread across the country from Boston to San Francisco, and three more sections are about to be added, in Los Angeles, Detroit and Cleveland. Commercial conditions have been bettered by the association, and much first-class co-operative work has been done with the National Electric Light Association, notably in parcel-post developments. Interest in the electric vehicle has been stimulated abroad by the association, and its domestic activities include extensive plans for the education of electric-vehicle salesmen, car owners and others along the lines so successful in the gasoline motor-vehicle industry. Valuable data as to the capacity, location and distance of adjacent charging points are to be printed in the "Automobile Blue Book of America" through the influence of the organization, and it is working hand in hand through committee membership with the standardization representatives of the Society of Automobile Engineers. The latter includes an electric-vehicle committee and is regarded as the leading technical body in the automobile industry. A reduction in the rentals of association electric garage signs from $5 to $1 has been made, and special attention is being given to the improvement of electrical conditions in gasoline garages. Regular publicity items are sent to about 100 newspapers from headquarters.

Electric Garages and Their Service

A paper by Mr. J. C. Bartlett, Philadelphia, described in detail the practice of the Bartlett garage, in which attention to detail, the close inspection of housed cars and a first-class electric livery are noteworthy features. The establishment saved investment cost by locating in the direct-current district, greatly simplifying the necessary charging equipment, which includes twenty-four 35-amp, six 65-amp and three 200-amp circuits, with room for 100 cars in a 70-ft. by 100-ft. house. The author condemned flat-rate storage charges, favoring separate billing for storage, deliveries and energy supplied. This practice improves the handling of cars by owners and insures better charging and maintenance. With the flat rate there is danger of sulphating batteries by neglect on the part of garage attendants. When the author began business a profit of $100 per month was obtained in a small garage handling only a dozen electric cars. By means of rates permitting the building up of garages in various neighborhoods a central station can be of great assistance. The average gasoline garage is a poor place for the electric vehicle, which is so free from repairs that it does not interest the garage owner, and which is often neglected. Continuous mechanical and electrical attendance throughout the daytime is desirable, with competent battery men on duty at night. Special care in sending cars out clean, in informing the owners when repairs are needed, in making minor adjustments, and in keeping thorough records of car movement, is a factor in the success of a commercial electric garage. A thorough monthly inspection, free to the customer, is given.

Utility of the Electric Vehicle

Mr. E. J. Bartlett, Baker Motor Vehicle Company, Cleveland, Ohio, was the author of a paper on the utility of the electric vehicle. He emphasized its advance into the touring field, citing runs by Colonel Bailey and speed tests as instances of the growing possibilities of the machine. The industry is now concerned with a man's car no less than with one appealing to women. In touring, a speed of 22 miles per hour is entirely feasible for many miles, and this is a sufficient average for most services. In the commercial field the speeds are from 7 miles to 13 miles per hour, according to the size of the truck, and these are a third below the gasoline machine speeds, which makes for lower repair bills

on the electric balance sheet. The electric vehicle can be counted upon for service 98 per cent of the time, compared with 85 per cent in gasoline and 75 per cent in horse service. The writer said that within a 50-mile daily service the electric vehicle generally can defeat the gasoline outfit on economical grounds. He quoted the following reliability figures from an installation whose service in the recent cold season was performed by electric and gasoline trucks about eighteen months old: Total truck days, 4900, of which 3400 were run by electrics. Troubles reported, 166. Of these, ninety-two were gasoline truck difficulties, and the unit troubles figured two per 100 truck days with the electrics and six per 100 with the gasolines. Of the seventy-four electric vehicle troubles, forty-three were caused by batteries excessively discharged, but no battery gave out before 5 p. m. Loose tires and broken chains were also among the principal causes of service interruption.

Discussion.

Messrs. Burleigh and Marshall discussed the paper, the former emphasizing the need of commercial education among central-station men concerned with the electric vehicle, and the latter the educational work contemplated by the national association.

The Relative Fields of Electric, Gasoline and Horse Trucks

The work of the Massachusetts Institute of Technology in the motor-vehicle field was reviewed by Mr. H. F. Thomson, research assistant in the electrical engineering department. The speaker emphasized the international interest in the investigations. The results have appeared in bulletin form with the exception of the later tabulations and their summary, which will be published in the near future by the Institute. Mr. Thomson gave a few extracts from the forthcoming bulletin which showed that inside a 2-mile radius there is little to choose in expense between horse and electric traction, but outside this range the electric vehicle is superior to other forms of transportation up to the limitations of a single charge of the battery. The limit is about 10 miles radius in parcel delivery and 6 miles in coal delivery. Efforts need to be put on the analysis of labor in delivery service and particularly upon the scientific layout of routes, rather than upon the cost of electricity for charging, since the latter can be doubled with only a small increase in the total operating cost. In a representative case a figured increase in energy cost of from 2 cents to 4 cents per kw-hr. raised the total expenses only 10 per cent. An approximate figure of $2 per 100 miles appears correct for the annual repairs of a 1-ton electric truck, between yearly mileages of 2000 to 10,000. As far as the records indicate, there is less difference in maintenance between electric and gasoline trucks than is generally supposed, but the reliability coefficient of the former is easily 95 per cent as against 75 per cent in the latter.

Discussion

Mr. Royal B. Daggett, Commercial Truck Company of America, Boston, questioned the preliminary figures of the foregoing speaker, suggesting that with the improved handling of electric trucks sure to result from their wider service lower costs are to be expected. He felt that the superiority of industrial electric trucks in factories, etc., hinted the economic possibilities of larger vehicles in short-radius service. The following figures were given by the speaker as representative: Cost of operating a 1-ton electric truck 30 miles per day, $7, compared with $4 for a horse limited to 15 miles service; cost of operating the truck 60 miles per day, with an extra battery, $9.80, compared with $16 for a similar four-horse service. Messrs. Marsh, Baker and L. P. Abel, consulting traction engineer, Boston, also spoke briefly, the last emphasizing the vital necessity of skilful route selection in economical operation. In a case cited by Mr. Abel the delivery cost per case increased from 4.5 cents to 19 cents because the drivers were not versed in the best ways of covering the territory.

Touring by Electric Automobile

Mr. J. S. Codman, Boston, read an interesting paper upon the present status of electric automobile touring, with a comprehensive introduction summarizing the various runs of Colonel Bailey and others within the past few months. The figures showed that, given adequate charging facilities, the electric passenger of the roadster type is perfectly able to traverse the countryside under even adverse road and weather conditions, and that grades and rough highways are not real obstacles. The most important point is the ability to obtain boosting charges, and at present local central stations are very poorly prepared for this, although the engineering and financial difficulties are more imaginary than real. The most recent trip of note by a Bailey electric was a run between Boston and New York on May 14-15, which was accomplished in twenty-three hours, nine minutes, the odometer reading 247.8 miles. On the road the running time was ten hours, fifty-two minutes. At five points boosts or charges were given, the total time thus required being ten hours, twenty-three minutes. The trip was made with a consumption of 3.04 amp-hr. per car-mile.

The author pointed out that the delay entailed by boosting is not serious, since inputs at high rates can be utilized with the modern storage battery, provided that care is taken to avoid gassing. In a case cited the author had boosted a 45-amp Edison battery for one hour at 200 amp, and enough energy was absorbed to enable the car to negotiate the next 50 miles. Too few central stations are prepared to supply direct current of such high value, but it ought to be fairly easy to arrange this by means of connections with the exciter bus, depending upon the instruments carried upon the car if necessary to check the input from the bus in stations not having other suitable instruments. The cost of the necessary wiring and rheostat should be nominal. There are only twenty-eight towns out of more than 300 in Massachusetts where a charging current in excess of 50 amp can be obtained for boosting service.

Discussion

The paper was freely discussed by Messrs. Abel, Marshall, J. W. Cook, of the Electric Storage Battery Company, Boston; P. A. Kelley, of the Philadelphia Storage Battery Company, Boston; F. B. Neely, R. B. Daggett, E. Y. Stimson; Albert Weatherby, and William G. Bee, of the Edison Storage Battery Company, Orange, N. J. The speakers generally agreed that boosting at high rates does not injure the modern battery, whether of the Edison or lead type. The point was made that if a battery has been discharged by 100 amp-hr., the boosting charge can be "put in" at 100 amp, reducing this rate as fast as the meter shows that the cells are being filled. At an indication of 80 amp-hr. out, the boosting rate would be 80 amp, and so on. Mr. Cook said that by charging a lead battery at a constant voltage 90 per cent of the charge could be absorbed in three hours. Fifty per cent would be absorbed in the first hour. In all such work it is necessary to look out for gassing and abnormal temperatures, say, above 110 deg. Fahr. The speakers also cited instances of storage-battery electric-railway cars which gave excellent daily mileage records by boosting the cells at odd times which did not interfere with the

schedules. Electric taxicabs are being considered for the Grand Central Station service in New York, on account of their absolute freedom from objectionable fumes.

Recognition of the Electric Vehicle

Mr. Hayden Eames, Standard Electric Company, Cleveland, submitted a paper in which the practical achievements of electric-vehicle service were sketched. The writer commented upon the high economy of the electric vehicle and outlined the value of personal recommendations from users in the electric-vehicle campaign.

Competition, Fair and Unfair

A paper advocating the application of the golden rule to the automobile business was read by Mr. A. V. Shaw, of the Peerless Motor Car Company, Boston. The author attacked the practice of "knocking" one's competitors and their wares and set forth the merits of co-operation, competition and publicity as a slogan for present-day salesmen. The paper was briefly discussed, the burden of the remarks being the benefits of a square deal among rivals.

Analysis of Sales Methods

An open business forum was conducted by Mr. C. D. Marsh, New York, at the closing session. By means of a skeleton diagram, the speaker set forth the fundamental features of business getting by electric-vehicle salesmen and the classification of advertising methods. Various types of reports and records of dealings with prospects were commented upon. An interesting feature was a talk by the leader of the discussion upon the preparation of form letters and various plans by which these can be given individuality.

Discussion

A somewhat rambling discussion followed the remarks of Mr. Marsh. The consensus of opinion was that souvenir programs are about the worst medium of electric-vehicle advertising. Colonel Bailey brought out the point that the sale of an electric roadster to a present car owner is an easier problem for the seller of cars than to market a machine anywhere else. Surprising as it appears, the average speed of the Bailey car on the road exceeds that of the usual gasoline machine. The latter seldom exceeds 19 miles per hour, and that of the former is regularly from 20 to 22 miles per hour. About 50 per cent of these electric roadsters are sold to men. Mr. Marsh, responding to an inquiry, advised spending $250 on newspaper advertising and $750 in circularizing, letters and follow-up work, assuming a yearly appropriation of $1,000 for electric vehicle exploitation by a Boston agency. Mr. Louis D. Gibbs, Boston Edison Company, added a humorous but practical touch to the discussion.

Weak Links in the Chain of Electric-Vehicle Salesmanship

Mr. F. Nelson Carle, manager of publicity for the General Vehicle Company, Long Island City, N. Y., presented a paper filled with concrete evidence of the difficulties besetting the salesman in the electric-truck field. He pointed out that only about 3 per cent of the prospective customers at any one time become early buyers, and even after contracts are signed serious complications often arise through changes in mind on the part of purchasers, modifications of drawings and specifications, insistence upon unusual dimensions and special equipment, and from abuse when the apparatus goes into service. It is no exaggeration to say that the salesman must work on a "prospect" something like one and three-quarters years before he secures his business.

The author contended that among the needs of the industry on its commercial side are a broader knowledge of different trades, with co-operation in different localities along the line of visits from specialists in different industries about to be motorized; better interchange of data bearing on propositions and sales between local offices and headquarters; avoidance of engineering freaks in truck designs and the tabooing of pet scheme of salesmen interested in technical details to the exclusion of sensible engineering solutions of problems; better success in training the purchaser toward accepting standard equipment when possible; the elimination of trade deals and concessions by agents who value their commissions more than the good of the industry, and the paying of more attention, by larger sales forces, to really interested "prospects" in smaller cities and towns. Multiplied sales of standard machines are the prime necessity of the present.

Outings

The entertainment features of the convention included a steak dinner cooked by electricity in the restaurant of the Boston Edison Company at the Massachusetts Avenue garage and an outing and shore dinner at the Relay House, Bass Point, Mass., on the last day of the convention calendar.

Southwestern Convention at Galveston, Tex.

The tenth annual convention of the Southwestern Electrical and Gas Association, held at Galveston, Tex., May 20 to 23, represented a departure from the program arrangement usually adopted by state and sectional associations, in the respect that few formal papers were presented during the various parallel sessions of the four-day meeting, most of the time of the convention being instead devoted to the discussion of practical organization, commercial and operating problems.

As explained by President G. H. Clifford, Fort Worth, Tex., in his opening address, general technical topics are already well covered in the engineering journals and in the transactions of the national scientific and engineering societies, so that state and sectional associations may best profit from the discussion of local subjects, operating problems, and other similar questions of immediate and special application. President Clifford also recommended that the association hold mid-winter meetings in addition to its present annual conventions, a proposal which received unanimous approval.

The attendance at the Galveston meeting numbered 350. The delegates were welcomed to "the Atlantic City of the Southwest" by Mr. Morris Stern of the Galveston Commercial Association. In a witty address Mr. Stern extended a hearty greeting to the utility operators and, in the course of his remarks, urged that legislators, both national and state, cease their destructive attacks on big business organizations, substituting if necessary proper regulation by business men of broad caliber. Mr. W. L. Wood, Jr., Texarkana, Ark., responded to the welcome on behalf of the association.

Membership and Committees

The report presented by Secretary H. S. Cooper, Dallas, Tex., showed the association to have 119 active members and 100 associates, making the largest enrolment in its history. This membership list includes every electric interurban and railway company in Texas, except one, every electric lighting company in cities over 5000, and thirty companies in towns of less than 5000.

President Clifford then announced the following committees: On the president's address—Messrs. R. B. Stichter, Dallas, Tex.; F. G. Murphy, Brownwood.

Tex., and J. C. Kennedy, Brenham, Tex. Finance—Mr. J. P. Griffin, Dallas, Tex., chairman. Resolutions—Messrs. C. W. Kellogg, Dallas, Tex.; W. B. Head, Dallas, Tex., and E. J. Emerson, Beaumont, Tex. Nominating committee—Messrs. E. T. Moore, Dallas, Tex.; F. Lege, Jr., Galveston, Tex.; F. R. Slater, Dallas, Tex.; John Carpenter, Corsicana, Tex., and T. T. Malone, Plainview, Tex.

Reducing Energy Consumption of Street Cars

"Economy in the Use of Energy in Street Railway Service" was the title of the paper presented by Mr. George G. Morse, El Paso, Tex., and read in his absence by Mr. C. W. Kellogg, Dallas, Tex. By installing watt-hour meters on the cars and determining "bogey" energy-consumption values for each run with each type of car it was found possible to reduce the energy consumption per car-mile from 2.61 kw-hours to 2.39 kw-hours. The result was a saving of 623,643 kw-hours in two years' operation representing a cash saving of $4,000, said Mr. Kellogg. As the meters cost but $2,400 to install, the investment paid a return of almost 200 per cent. Use of the meters has also enabled car defects, tight brakes, improper wheel gages, etc., to be detected and corrected, and has further resulted in more careful handling of the car equipment by the men.

In the discussion Mr. E. J. Emerson, Beaumont, Tex., reported reducing the energy consumption on his lines from 2.8 kw-hours to 2.02 kw-hours by applying watt-hour meters to the cars. Mr. E. E. Nelson, Fort Worth, Tex., pointed out the advantages of coasting time recorders over the watt-hour meter method, and reported obtaining an immediate saving of 19 per cent of energy through the use of the former device.

Water-Power Transmission and Distribution

At the electric-light session of Thursday morning, Mr. W. L. Wood, Jr., presiding, Mr. H. T. Edgar, of the Stone & Webster Corporation, Boston, Mass., read a paper outlining the extent of energy transmission and distribution from the great Keokuk (Ia.) water-power plant. This development, the largest in the world, is located near the country's center of population and within easy transmission distance of many thriving towns and cities. The water-power thus developed will, the speaker predicted, eventually create an industrial and manufacturing district 100 miles long and 50 miles wide in the Mississippi River region, which will be without an equal in the country.

Central-Station Sales Policies

Secretary Cooper opened the discussion on the sale of appliances by central stations with a citation from the association Question Box, urging electric-service companies to avoid selling devices unless compelled to by apathetic local conditions.

Mr. A. W. Wallace, Jacksonville, Tex., insisted that central stations in communities under 5000 must take appliance sales into their own hands as competent dealers and contractors are rarely found in such places.

Mr. C. W. Kellogg said that at El Paso the central station sells appliances but also furnishes devices to contractors at cost, an arrangement which seems to satisfy the dealers.

Mr. J. C. Kennedy, Brenham, Tex., described his unit outlet system of computing wiring prices. He advised selling apparatus at a reasonable profit, declaring that the customer gives the company no credit for reduced prices.

Mr. J. E. Cowles, Shreveport, La., urged that the central station assume the roll of educator rather than that of merchant.

Mr. W. J. Drury, Dallas, Tex., admitted that in some small communities the central station must sell appliances, but declared that in larger cities the lighting companies will gladly turn this business over to the contractors.

Mr. W. A. Guthrie, San Angelo, Tex., recommended house demonstrations of devices, since the best class of customers, he said, pay by check and seldom enter the electric company's office or display room.

Secretary Cooper also opened the discussion on the sale of lamps by central stations, concluding with advice to the electric company to "stick to its last" and to simplify its business to the furnishing of electric service only.

Mr. F. R. Slater, Dallas, Tex., recommended "commercialization" of the contractor, educating him in business principles.

Mr. C. K. Chapin, Memphis, Tenn., said that the Memphis company delivers, free, all renewals of tungsten lamps, and also installs free of charge the original installation, for which no deposit is required. The cost of this renewal service amounts to 0.5 cent per kw-hour. He advocated the idea of selling not alone electrical energy, but "lighting service" in its broadest sense.

At the accounting session of Thursday morning, Chairman R. G. Carroll, Fort Worth, Tex., delivered an address on the subject of a uniform system of accounting for the public utilities of Texas. He emphasized particularly the need for such a system on the part of the smaller plants, and declared that its adoption would anticipate the state in enforcing unwelcome standard accounting methods.

Developing the Electric Vehicle Load

Mr. C. K. Chapin, chief electrical engineer of the Memphis (Tenn.) Consolidated Gas & Electric Company, on Thursday afternoon presented an interesting analysis of the benefits of electric-vehicle charging loads for central stations and urged the development of this profitable class of business. The Memphis company is unique in operating a service garage for the benefit of its customers. In this garage the various items of energy furnished, washing, delivering, and general inspection of cars, are charged for separately, the garage income per car ranging from $35 to $15 per month, depending on the service desired.

Mr. J. C. Kennedy, Brenham, Tex., reported the successful use of a 2-ton electric truck for ice delivery from his combination plant.

Operating Organization

That the manager of the small central station can with advantage apply to the organization of his own operating staff the same principles employed by the big utility companies was pointed out by Mr. J. C. Kennedy, Brenham, Tex., in his paper of Friday morning. The scheme of organization within the Brenham ice-electric company was illustrated graphically, but the points of greatest importance in any organization, said Mr. Kennedy, are, in their order, the capability, adaptability and congeniality of its individual constituent units.

Principles of Public Policy

"Public Policy of Public Utility Corporations" was the subject of the paper by Mr. F. R. Slater, general superintendent of the Texas Power & Light Company, Dallas, Tex. The average utility customer has very little, if any, concern about franchise rights, public ownership and the other larger problems affecting the industry. But the treatment he receives from the corporation's employees is personal and if they show him courteous consideration the company is given most of the credit. The value of frank and friendly relations with the press as a means of putting the corporation's

case fairly before the public was also emphasized. Already there is being established, said Mr. Slater in conclusion, a harmonious spirit of co-operation between the utilities and those whom they serve, and the public is coming to realize that the public-service corporation is an integral and important part of the community and as such is entitled to the same courtesy, fairness and impartiality shown every other business interest.

The draft of a proposed law to make the theft of electricity in Texas punishable by a maximum fine of $25 or imprisonment for six months was presented by a special committee comprising Messrs. H. C. Morris, W. W. Reed, R. C. Brooks and E. C. Bartholomew. Messrs. Kellogg, Hegarty, Cooper, Rathell and Cushman commented briefly on the provisions of the act.

Mr. Homer R. Mitchell, Dallas, followed with an address on the Texas Employers' Insurance Association which was created by the recent Texas employers' liability act to insure employers at cost. The plan is modeled after that of the Massachusetts statute, and the operation of the law, declared Mr. Mitchell, has been attended by savings for both employers and injured employees. Mr. Mitchell was preceded by Mr. W. B. Head, Dallas, who spoke as a member of the insurance board.

"Safety First," the topic with which the session of Friday afternoon was opened, was discussed from the variant viewpoints of a street-railway manager, a claim agent, a lighting-company manager, a gas company executive, and the editor of a city newspaper.

Mr. R. T. Sullivan, Houston, Tex., said that the street-car men have long been exerting every effort in the interests of safety, but declared they yet need more co-operation from the public.

Mr. H. W. Withers, Houston, Tex., pointed out that the claim department may minimize accidents and encourage carefulness by appealing to the employees' sense of humanity, self-protection and company loyalty.

Mr. F. N. Lawton, Wichita Falls, Tex., described a number of practical safety devices in use on his central-station system.

Mr. F. S. Wisely, San Antonio, Tex., spoke for the gas companies, and Mr. H. T. Warner, of the *Houston Post* discussed means of handling that minority of the public which must be kept from harm in spite of itself.

Mr. W. L. Wood, Jr., Texarkana, Tex., made an appeal for better fire-prevention methods in utility properties, through the protection of plants and equipment from hazards both external and internal. Continuous effort and eternal vigilance will be needed to reduce the present astounding fire loss which reaches 1000 miles of buildings each year.

Election of Officers

Saturday's session was given over to business discussion, and the following officers were unanimously elected: President, Mr. D. G. Fisher, Dallas; first vice-president, Mr. W. L. Wood, Jr., Texarkana; second vice-president, Mr. C. W. Kellogg, Jr., Dallas; third vice-president, Mr. F. R. Slater, Dallas; secretary, Mr. H. S. Cooper, Dallas; treasurer, Mr. J. B. Walker, San Angelo.

Mr. D. G. Fisher, the president-elect, is assistant general manager of the Texas Traction Company and the Southern Traction Company, operating interurban electric railways from Dallas to Waco, Corsicana and Denison, Tex. Mr. Fisher served the association for several years as secretary and has since held successively the various vice-presidencies.

Executive committee—Messrs. G. H. Clifford, D. G. Fisher, W. L. Wood, C. W. Kellogg, W. B. Tuttle, D. Daly, F. J. Storm, W. B. Head, H. C. Morris and F. R. Slater.

Advisory committee—Messrs. W. S. Rathell, W. A. Sullivan, F. G. Murphy, E. D. Kelly, A. W. Wallace, F. A. White, E. S. Fletcher, J. W. Carpenter, M. J. Loftus, J. E. Cowles, W. V. Wainwright, W. A. Guthrie, P. A. Rogers, R. Merriwether, R. C. Brooks, J. L. Stevenson, E. J. Emerson and V. W. Berry.

Finance committee—H. S. Potter, G. H. Cushman and C. E. Calder.

The beautiful Hotel Galvez, commanding a superb vista of the Galveston sea wall, beach and Gulf of Mexico, served as headquarters of the convention. An opening reception and ball, a card party, boat rides, fishing expeditions and bathing parties were features of the entertainment program.

On Friday evening the Jovian Order held its parade, rejuvenation and banquet. Visiting Jovians and others

PRESIDENT-ELECT D. G. FISHER

were frank in conceding the procession and initiation ceremony to be the most elaborate and handsomely staged of their kind ever attempted anywhere in the United States. Five huge electric trucks carried floats depicting the evolution of the lighting art, the development of electrical inventions, the apotheosis of Jovianism, etc. Not only were the floats themselves elaborately illuminated, but cables from the truck batteries led to 160 banners, each carried by a red-clad marcher and lighted by eight 11-volt, 5-watt sign lamps in series on the 90-volt battery circuits.

The parade, rejuvenation and electrical effects were arranged by the local Jovians led by Messrs. W. R. Phipps, Claude Matthews, K. E. Mason, W. D. Masterson, Max Levy, J. B. Harris and A. E. Kirk. At the banquet which followed the rejuvenation, Past-Jupiter H. B. Kirkland, Pittsburgh, Pa., was toastmaster and there were addresses by Jupiter W. N. Matthews, St. Louis, Mo., and Messrs. W. B. Head, Dallas, Tex.; F. R. Slater, Dallas, Tex., and Max Levy, Galveston, Tex.

Cleveland Electrical Show

The opening ceremony of the Cleveland Electrical Exposition began promptly in the Coliseum at 7 p. m. May 20. Mr. Charles F. Brush, the inventor of the arc lamp, was the principal speaker of the evening. He was introduced by Mr. George S. Millar, president of the Electrical League of Cleveland, which promoted the exposition. Directly following the ceremonies the exposition was formally opened to the public by Mr.

Thomas A. Edison, who from his laboratory in Orange, N. J., closed the Western Union connection, ringing a bell in the Coliseum. In a moment the large hall was flooded with lights of dazzling radiance and rainbow tints.

The general arrangements of decorations and exhibits is such as to allow the beauty of the lighting to be seen from any point in the hall. The two most striking features are the hundreds of semi-indirect lighting bowls, which are constantly changing in color, giving a charming variety of colored lighting, and the runway leading into the exhibit hall, the entire ceiling of which is a blaze of varying colors showing through a diffusing screen and impressing upon those who enter the idea that they are passing under falls of many colored waters.

The exterior lighting is brilliant. Beginning at the main thoroughfare of Cleveland, Euclid Avenue, and extending to the entrance of the Coliseum, the street is roofed with strings of lamps, and at the sides over the curbing are hung 1000-watt gas-filled lamps spaced about 15 ft. apart, making the lighting at night on the street and sidewalks very bright.

The number and variety of the exhibits equal those of any other electrical show held in this country, there being more than 100 different exhibitors.

A. I. E. E. Affairs

At a meeting of the board of directors of the American Institute of Electrical Engineers held on May 19 authority was given to extend the territory of the Portland Section to include Corvallis, Eugene, The Dalles, Astoria and Tillamook, Ore., and Winlock, Wash.

A communication was presented from the library board of the United Engineering Society requesting the appointment of a representative of the Institute upon a joint committee to consider the question of duplication of the exchange of publications and the possibility of retrenchment in the expenses incurred by these duplications. President Mailloux was authorized to appoint this representative.

Past-president John W. Lieb was appointed to represent the Institute at the Cooper Union commencement exercises on May 29, at which a tablet to the memory of Prof. William A. Anthony, a past-president of the Institute, will be dedicated. On Tuesday evening, May 19, members of the board of directors and a few personal friends of Mr. Herman Aaron attended an informal dinner at the Engineers' Club, New York, when a silver service of eight pieces was presented to Mr. Aaron as a token of the appreciation on the part of the Institute of the services rendered by him gratuitously during the ten years he acted as its legal counsel. President Mailloux presided, and the presentation address was made by Mr. J. J. Carty, who is entitled to the credit of obtaining the services of Mr. Aaron ten years ago, at which time Mr. Carty was chairman of the finance committee and a member of the board of directors. Mr. Carty spoke feelingly of the valuable services rendered by Mr. Aaron at the time negotiations were being carried on relative to the proposed gift by Mr. Carnegie to the engineering profession of a suitable building as a home for the principal national engineering societies, and he paid a high tribute to the public service rendered by Mr. Aaron at that time and also as general counsel of the Institute during the entire last decade. After an appropriate response by Mr. Aaron, all present joined in expressing their high opinion of the able, loyal and exceedingly efficient services rendered by Mr. Aaron to the Institute.

Public Service Commission News

New York Commissions

As the New York Public Service Commission, Second District, has approved the consolidation of the Cataract Power & Conduit Company and the Buffalo General Electric Company, Mayor Fuhrmann, of Buffalo, has been asked to approve the merger.

Governor Glynn has appointed Mr. Robert C. Wood to succeed Mr. John E. Eustis as a member of the New York Public Service Commission, First District. Mr. G. M. S. Schulz was appointed to take this office on March 28, but did not qualify. Mr. Wood was formerly a member of the firm of Wood & Havemeyer, bankers and brokers. This firm was dissolved recently.

California Commission

The Railroad Commission of California has rendered a decision authorizing the Downey Light, Power & Water Company to sell its electric system in Los Angeles County to the Southern California Edison Company for $50,938. The selling company has been receiving a rate of 15 cents per kw-hr. for lighting purposes and 6 2/3 cents per kw-hr. for motor service The Southern California Edison Company will reduce the rate for lighting on a sliding scale of from 7 cents per kw-hr. to 2½ cents per kw-hr. and for motor service on a scale of from 6 cents per kw-hr. to 1½ cents per kw-hr.

Ohio Commission

The decision of the Public Utilities Commission of Ohio in the case in which the Bucyrus Light & Power Company appealed from the action of the Bucyrus City Council has been announced.

A number of the principles for which the company contended were recognized by the commission, though some of the values were reduced. For the items of intangible value the commission allowed $14,000, or about 19 per cent of the value of tangible property with the exception of real estate. The company claimed $54,860 for the intangible value, the amount being found by taking certain percentages of a claimed reproductive value of $122,268. The commission pointed out that depreciation had not been taken into consideration by the company in the intangible values, as it had on the value of the tangible property. The items considered under this head are cost of engineering, superintendence, insurance, taxes, legal expenses, interest during construction, financing and development. While the commission recognized the item of financing and development under this head, its opinion of the amount differed widely from that of the company.

In arriving at the valuation of the property the commission took into consideration the appraisals made by the city experts, the company experts and Mr. L. G. White, representative of the commission, and an average was then secured. The reproduction cost was found and from this the depreciation was deducted to obtain the present value of the physical property. As to the amount of depreciation in this case the commission followed the figures of its own representative rather than those of either the company or the city. Mr. White estimated total depreciation at $20,674. The commission suggested that a company should have at least $5,000 working capital. In this case the supplies were counted as part of the working capital and the Bucyrus Light & Power Company was allowed a small sum in addition.

The value of the physical property was placed at $81,000 by the commission, and to this was added the $14,000 for intangible value, making $95,000 to be considered for rate-making purposes.

Current News Notes

Providence (R. I.) Electric Pumping Contract.—The Narragansett Electric Lighting Company, of Providence, R. I., has obtained a seven-year municipal water-pumping contract with a three-year renewal proviso. A 1300-hp synchronous motor driving a centrifugal pump of 13,000,000-gal. capacity will be installed.

* * *

Street Paving as Affecting Electrolysis.—In a recent case before the Public Utilities Commission of Ohio a street-railway company accused of causing damage by the electrolytic action of leaking electricity put in an answer to the effect that the street paving is in such bad condition that it is impossible to maintain proper bonding to prevent electrolysis.

* * *

Turbines in Hauto Plant.—On page 1039 of the *Electrical World* dated May 9, 1914, in an article relating to the Hauto (Pa.) plant of the Lehigh Navigation Electric Company, it was stated that the blading of the steam turbines is "a modification of that used in the Rateau machine as developed by the Allgemeine Elektricitäts Gesellschaft, while the governing parts, impulse nozzles and their wheels are essentially the same as those employed in the Curtis turbine." It should have been stated that these turbines were developed and built in this country and not in Germany. They are of the type that has been standardized by the General Electric Company.

* * *

Electrical Term for Hotel Advertising.—In a recent advertisement in an American newspaper for the Savoy Hotel, London, Eng., use was made of the term "load-factor" to emphasize the advantages of this well-known hostelry. The text in part is as follows: "Have you ever heard the expression 'load-factor'? Do you know what it means? It is used in connection with the supply of electricity. If an installation is able to dispose of its full current during every hour of the twenty-four hours, it is said to have a 'load-factor' of 100 per cent. If it can dispose of it only during twelve hours of the twenty-four and is idle for the remaining twelve hours, it has a 'load-factor' of 50 per cent, and so on." It then goes on to explain why the Savoy Hotel can provide so many conveniences to the public at moderate charges on account of its 100-per cent load-factor.

* * *

The Electrified Defences of Matamoras, Mexico.—During one of the attacks made by the Mexican constitutionalists upon the federal forces in the city of Matamoras, Mexico (which is just opposite Brownsville, Tex.), the defending federal troops intrenched themselves behind a barricade of barbed wire, and then, as an afterthought, their commander hit upon the pleasant scheme of connecting this barbed wire to the lines of the Matamoras electric plant so that a deadly shock would be given persons making contact with it. During a fierce assault on the federal works six or seven constitutionalist soldiers were electrocuted by the wire before the deadly nature of the barricade became known. Withdrawing his infantry for the time being, the rebel general then directed his field guns upon the electric plant with the result of quickly shutting it down. Returning to the assault, the now innocuous barbed-wire entanglement proved only a slight obstacle to the final capture of the city by the constitutionalist forces.

SOCIETY MEETINGS

Annual I. E. S. Convention in Cleveland.—The annual convention of the Illuminating Engineering Society will be held in Cleveland during the week of Sept. 21, 1914.

* * *

Canadian Electrical Association.—The annual convention of the Canadian Electrical Association will be held in Montreal, Que., June 24, 25 and 26 in the rooms of the Canadian Society of Civil Engineers.

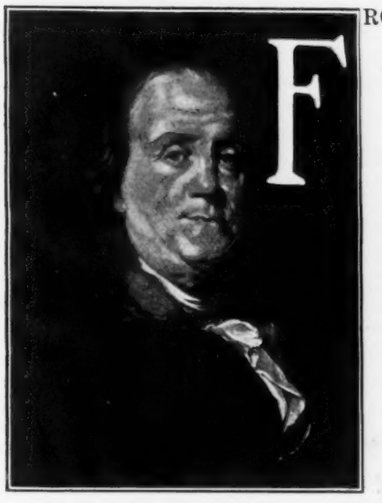
* * *

Awards Made in New York Companies' Section N. E. L. A. Contest.—At a meeting of the convention contest committee, New York Companies' Section, N. E. L. A., held in the Consolidated Gas Building, May 25, the following ten contestants were each awarded a prize of $50 to be used to pay the expenses of attending the Philadelphia N. E. L. A. convention: Mr. J. Walker Eaton, the New York Edison Company; Mr. S. H. Cleeland, Jr., the New York Edison Company; Mr. H. J. Garnier, the New York Edison Company; Mr. F. E. Boyland, the New York Edison Company; Mr. G. W. England, New York & Queens Electric Light & Power Company; Messrs. J. Messler, Westchester Lighting Company; R. I. Shannon, United Electric Light & Power Company; E. J. Reilly, the Yonkers Electric Light & Power Company; H. J. Otto, the Yonkers Electric Light & Power Company; E. J. McMahon, the Yonkers Electric Light & Power Company. The contest has been conducted by a committee under the chairmanship of Mr. L. A. Coleman, of the United Electric Light & Power Company, and has been going on since November, 1913. The winning contestants will attend the convention as the unofficial representatives of the New York Companies' Section, N. E. L. A., as well as being the companies' direct representatives.

* * *

Illuminating Engineers Meet in New York Department Store.—The Illuminating Engineering Society, New York Section, held its May 21 meeting in the auditorium of the recently completed Lord & Taylor department store. Mr. Bassett Jones delivered an illustrated lecture on the lighting of the building, describing the illumination of the French salon, concert hall, evening rooms, show windows, etc. He called especial attention to the methods of securing an artificial approach to daylight in certain parts of the store where this light is required. The speaker said that to attempt to illumine an entire store with artificial light approaching that of subdued daylight would be unnecessary and entirely too expensive as too much energy would have to be available at each fixture outlet. Commenting on the types of reflectors and lamp units employed, Mr. Jones declared that the use of concentrated-filament lamps makes the design of reflectors a simple problem. He believes that it is not necessary to design reflectors by theoretical computations, saying that it is simpler and just as effective to form their contours by geometrical construction. After showing that the illumination of a surface depends only on the flux angle and the intensity of the light source, the speaker indicated how a reflector could be designed by geometrical construction. After the lecture Mr. Jones conducted those present through the building showing them the artistically illuminated restaurant and the stage for theatrical gown "try-ons," and demonstrated the operation of the foot, border and drop lamps. Among other innovations shown were the daylight room for the inspection of silks, and the show windows equipped for dressing in the basement. A detailed description of the illumination of this store was published in the May 23 issue of the *Electrical World*.

SYSTEM OF PHILADELPHIA ELECTRIC COMPANY



B. Franklin

FROM its three integral but interconnected systems, covering a territory roughly 40 miles long and 15 miles wide, the Philadelphia Electric Company serves 55,000 customers, including many large motor users, and supplies nearly one-half of the total energy requirements of the electric railways operating in its vicinity.

To meet the rapidly increasing demand for its service the company is now preparing to install the largest turbo-generator in the world—a 13,200-volt, three-phase machine rated at 35,000 kw. A corresponding increase in demand a year ago made necessary the raising of the transmission potential from 6000 volts to 13,200 volts, and coincidently the former two-phase system (adopted at the time the Philadelphia company was formed by the unification of a score or more small plants) is also being revised in favor of three-phase transmission to substations. This change, as well as the retention of two-phase, 2400-volt distribution from substations, has brought about many interesting applications of very large Scott-connected transformer banks, which are among the characteristic features of the Philadelphia company's sixty-cycle system. The company also operates from the same plants an extensive twenty-five-cycle system, the principal part of this output being taken by the railways already referred to.

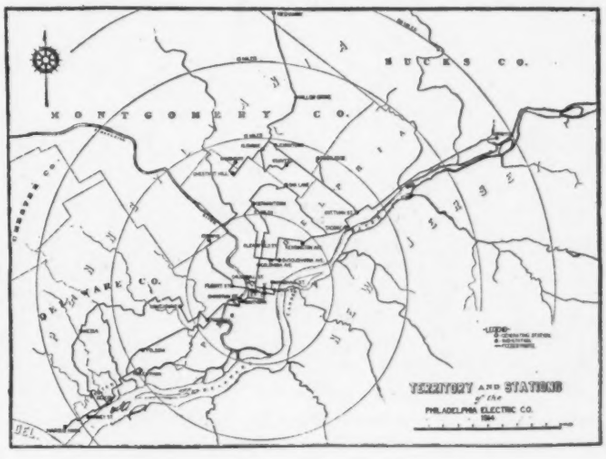
Each of the three geographically distinct systems operated by the company has its own generating station, but tie-lines connect these systems so that a single huge network results.

The power plant for the Philadelphia metropolitan district is situated at Christian Street and the Schuylkill River, but this generating center will shortly be augmented by a new station adjoining the old one.

The lines of the Northern District of the Philadelphia Electric Company include a number of railway substations containing sixty-cycle rotary converters, and are served by the Tacony (Pa.) plant, which has 17,500 kw in steam units.

The region surrounding Chester, Pa., is supplied from the 8500-kw Chester station of the Beacon Light Company, which is a subsidiary of the Philadelphia Electric Company and is operated as part of its system.

In addition to these three generating plants and a "stand-by" emergency generating station, the Philadelphia Electric Company system includes a total of



thirty-four substations. During 1913 the total output of the combined system was 253,000,000 kw-hr., with a maximum peak load of 82,200 kw. The connected load was 150,000 kw, exclusive of 27,000 kw supplied for railway purposes. For the year mentioned the system load-factor was 35.1 per cent, on the basis of a twenty-four-hour day. The company's employees number 2500.

The Philadelphia Electric Company has its own engineering staff, which designs and executes all construction work, both electrical and mechanical, in connection with stations, overhead and underground circuits and even service connections on customers' premises. Not less striking than the number of original practices locally devised and instituted on the company's system is the high degree of standardization achieved in the construction and operation of this extensive system of generating plants, lines and substations.

The World's Largest Turbine Electric Unit—35,000 Kw

In its new "A-2" generating station which the Philadelphia Electric Company is now erecting, adjoining its present Christian Street plant, the "A-1" station, there will be installed during the present year a 35,000-kw steam-turbine set, the largest prime-mover unit ever built. This huge machine was described in the *Electrical World* for May 2 of this year, but a recapitulation of its main features will not be out of place here. It will be of the General Electric horizontal type, will weigh 600 tons, and will measure 63 ft. 2 in. in length, 21 ft. 7 in. in width and 15 ft. 10 in. in height. Its thirteen-stage Curtis-type steam element will operate on steam at 215 lb. pressure and 150 deg. Fahr. superheat.

Exhausting against a back pressure of 1.5 in. of mercury, absolute, this big turbine is expected to deliver 1 kw-hr. for each 11.8 lb. of steam consumed at loadings of about 25,000 kw, while at full rated load 35,000 kw, it will consume about 12.5 lb. of steam per kilowatt-hour. The turbine will be equipped with a 50,000-sq. ft. surface-type condenser, which is being built by the Southwark Foundry & Machine Company of Philadelphia from designs prepared by the Westinghouse Machine Company, Pittsburgh, Pa. The circulating, air and hot-well pumps will all be furnished by the Westinghouse Machine Company. This huge condenser is of unique design and will have its tubes arranged in circular rows eccentrically within the shell. The air will be removed from the center, giving the steam a minimum path through the tubes. Employing the counter-flow principle, the condensate is allowed to trickle down over the hottest tubes and will be removed within a few degrees of exhaust-steam temperature.

The generator element will deliver 13,200-volt, sixty-cycle, three-phase energy, with a current output of 1460 amp per phase at full load and 90 per cent power-factor. The six-pole rotating field is driven at 1200 r.p.m. As designed, the armature will have an internal reactance of 10 per cent. Supported on a bracket on the bearing at the generator end will be a 150-kw, 250-volt, 600-amp shunt-wound exciter, direct-connected to the turbine shaft.

A feature of the construction of this huge machine will be the provision of thermo-electric couples in its windings, which couples will be connected to instruments that will show the attendants the temperatures existing at all times in various parts of the armature. The thermocouples are to be inserted at the bottom of the slots, at the ends of the coils, between the insulation and the windings, and at various other points where the existence of "hot spots" is suspected.

Other Features of the New "A-2" Generating System

In addition to the 35,000-kw, sixty-cycle turbine-alternator above mentioned, there will also be installed in the new "A-2" generating plant a 30,000-kw, 13,200-volt, three-phase turbine set delivering twenty-five-cycle energy. The two-pole rotating element of this unit will be driven at 1500 r.p.m. Besides the internal reactance of 8 per cent for which the machine is de-

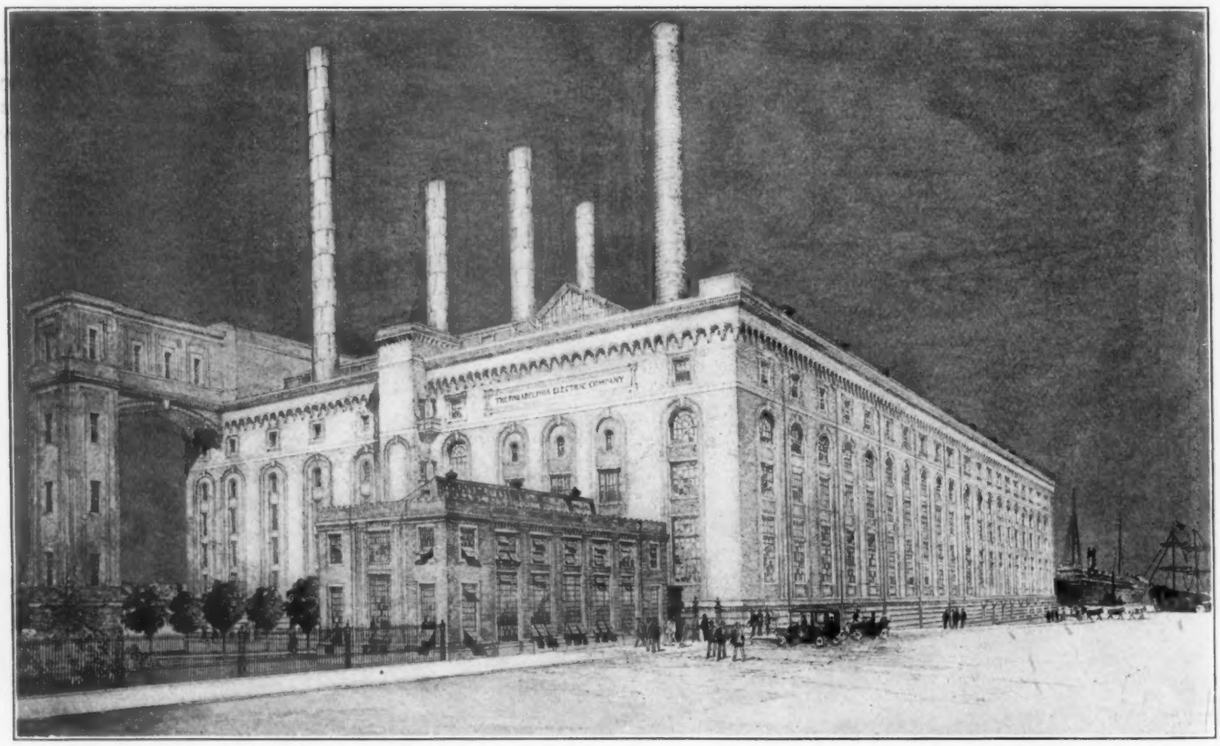


FIG. 1—THE NEW POWER HOUSE OF THE PHILADELPHIA ELECTRIC COMPANY AS IT WILL APPEAR WHEN COMPLETED

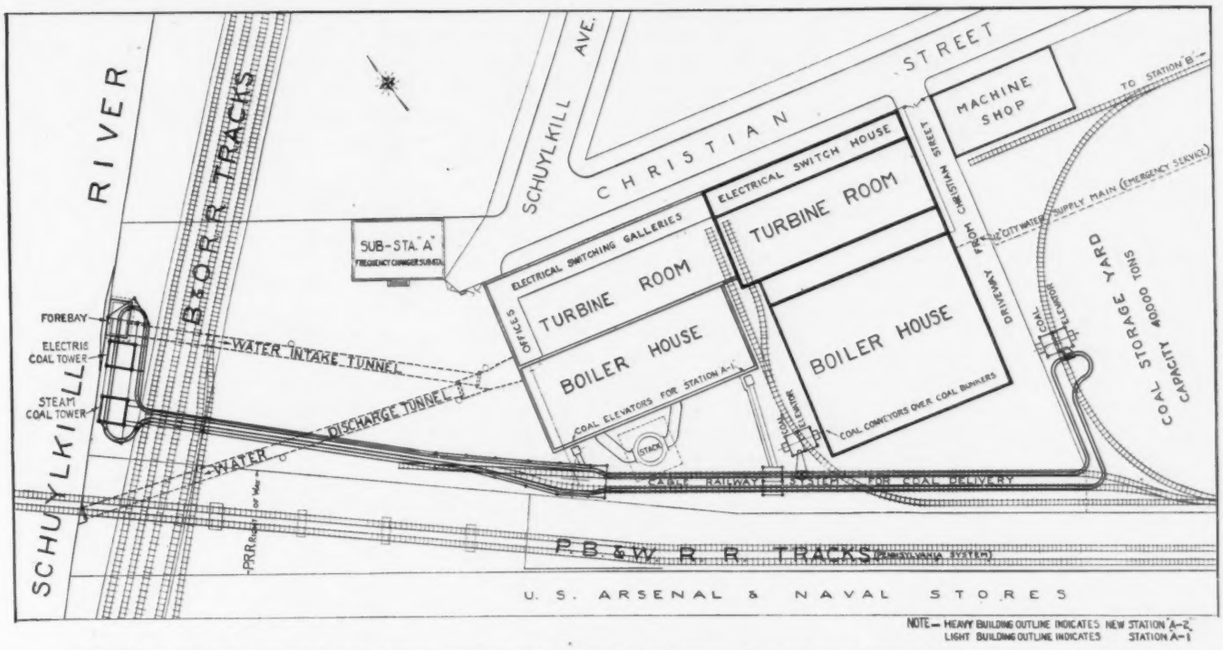


FIG. 2—LAY-OUT OF THE ENLARGED CHRISTIAN STREET STATION OF THE PHILADELPHIA ELECTRIC COMPANY

signed, 4 per cent will be added by means of external reactance coils, making 12 per cent in all. A similar bracketed-type individual exciter, rated at 110 kw and 250 volts, will be mounted on the end bearing of this machine. An auxiliary 500-kw steam-turbine-driven exciter will be provided for the "A-2" plant and will be of the gear-reduction type of drive.

Separate duplicate sets of unsectionalized high-tension busbars will be installed for each frequency, and provision will be made to control from the "A-2" station three of the turbo sets now operating in Station "A-1," as well as the frequency-changer sets in Substation "A" near by. Although actually containing only the two very large units already described, Station "A-2" will thus effect control of 69,000 kw in twenty-five-cycle apparatus and 50,000-kw in sixty-cycle machines, making a total available rating of 119,000 kw.

Except for these electrical interconnections and for the common condensing-water tunnels, there will be no physical connection between Stations "A-1" and "A-2." The buildings will be entirely separate, and no steam lines will be carried between the sets of boilers in the two stations. The steam equipment for the new station is to comprise twenty Babcock & Wilcox boilers, each rated nominally at 1000 hp and each capable of evaporating 60,000 lb. of water per hour. The boilers will be arranged on a single floor in four rows with one stack serving each row.

New Departures in Sectionalizing

In the design of the control connections for the new station radical departures have been made in the direction of sectionalizing to a degree never before attempted in American practice. Both the twenty-five-cycle and the sixty-cycle systems will be operated with grounded neutrals, and these mid-point connections will be provided with safety interlocks which will automatically prevent the connection of more than one machine of either frequency to ground at the same time. Each of the twenty-two twenty-five-cycle and fourteen sixty-cycle outgoing feeders will be protected with 3 per cent power-limiting reactances inserted directly in the lines. There will also be similar reactances in the tie-lines to Substation "A."

All feeders of both frequencies will be arranged in a group system of original design. Each group will contain two outgoing feeders, and the arrangement of cable connections will be such that no substation will be fed by more than one cable belonging to any one group.

The building for the new station will measure 188 ft. in length by 262 ft. in width, and it will reach a total height of 98 ft.

The Present Christian Street Plant

Although originally designed for and equipped with vertical compound engines of 5000-kw rating, the present Christian Street station now contains steam-turbine units exclusively. As shown in an accompanying illustration, these machines are all of the Curtis-General Electric vertical type. The variety of the units at present installed is best shown by the accompanying table.

PRIME-MOVER UNITS IN STATION "A-1"

Machine No.	Rating, Kva	Machine Voltage	Phase	Frequency, Cycles	Remarks
1	14,000	6,000	2	60	
2	15,000	6,000	2	60	With Scott-connected transformers.
3	12,000	6,000	2	60	
4	7,500	6,000	2	60	
5	7,500	6,000	2	60	With Scott-connected transformers.
6	15,000	6,600	3	25	With "step-up" transformers delivering 13,200 volts.
7	15,000	13,200	3	25	With 5 per cent external reactances.

As prominently shown in Fig. 3, the majority of the turbine units in this plant are equipped with barometric condensers, the exceptions being Nos. 1 and 6, which exhaust into surface condensers mounted in their bases. The circulating-water lines of these surface-type condensers are arranged with complete motor-operated gate valves, all controlled from a central point on the basement gallery. A high-water alarm gives

warning in case of failure of the condensate pumps and consequent danger of flooding the condenser.

Features of the Turbine Sets

The 6600-volt output of turbine set No. 6, it will be noted, is stepped up through a set of three 5000-kva single-phase water-cooled transformers to 13,200 volts for transmission purposes. As these transformer units are delta-connected on the low-tension side and have their high-tension windings star-connected, it will be observed that their own winding ratio is approximately one-to-one, although the voltage ratio obtained is two-to-one. No oil switch or other disconnecting feature is inserted between the generator and its compensators, which are treated as extensions of the machine armature itself. These main leads include, however, series transformers which operate ammeters. The generator leads carry 1312 amp per phase and are inclosed in brass piping.

No neutral is brought out from the mid-point of the compensator connections, although the armature windings are star-connected. These compensator units occupy a special fireproof compartment, which is ventilated quite separately from the rest of the station. An underground tank is provided for the rapid withdrawal of the oil in case of fire. A fourth spare compensator is also available in the event of accident to one of the operating units. This No. 6 turbine unit is synchronized and operated from the control gallery like any other generator in the plant, but its leads are connected, with interlocks, to the bus of the nearby railway frequency-changer substation.

Turbine set No. 7, installed within the first half of the present year, illustrates the advance in design and construction which occurred during even the few months separating the erection of these two units. Of the same kilowatt rating as No. 6, its generated potential is directly 13,200 volts without the use of compensators, which is resorted to in the case of No. 6. No. 7 is equipped with 5 per cent external reactances mounted on concrete cores and inserted in the generator leads.

Although turbo sets Nos. 2 and 5 are two-phase units, they are able to deliver energy to the three-phase, sixty-cycle system as well, through the means of Scott-connected transformers. The pair of 7500-kw transformers used with No. 2 has the distinction of being the largest set ever built for this purpose. The units are top-connected, oil-insulated and water-cooled. A similar pair of 3750-kw units serves turbo-generator No. 5. The large Scott-connected transformers for No. 2 contain internal reactance which serves as a power-limiting feature in case of overload or short-circuit.

The boiler house of the Christian Street plant parallels the axis of the turbine room and is double-decked, each floor containing in a double row twenty 630-hp Babcock & Wilcox boiler units with superheaters. Coal is delivered to the overhead bunkers by an inclined in-

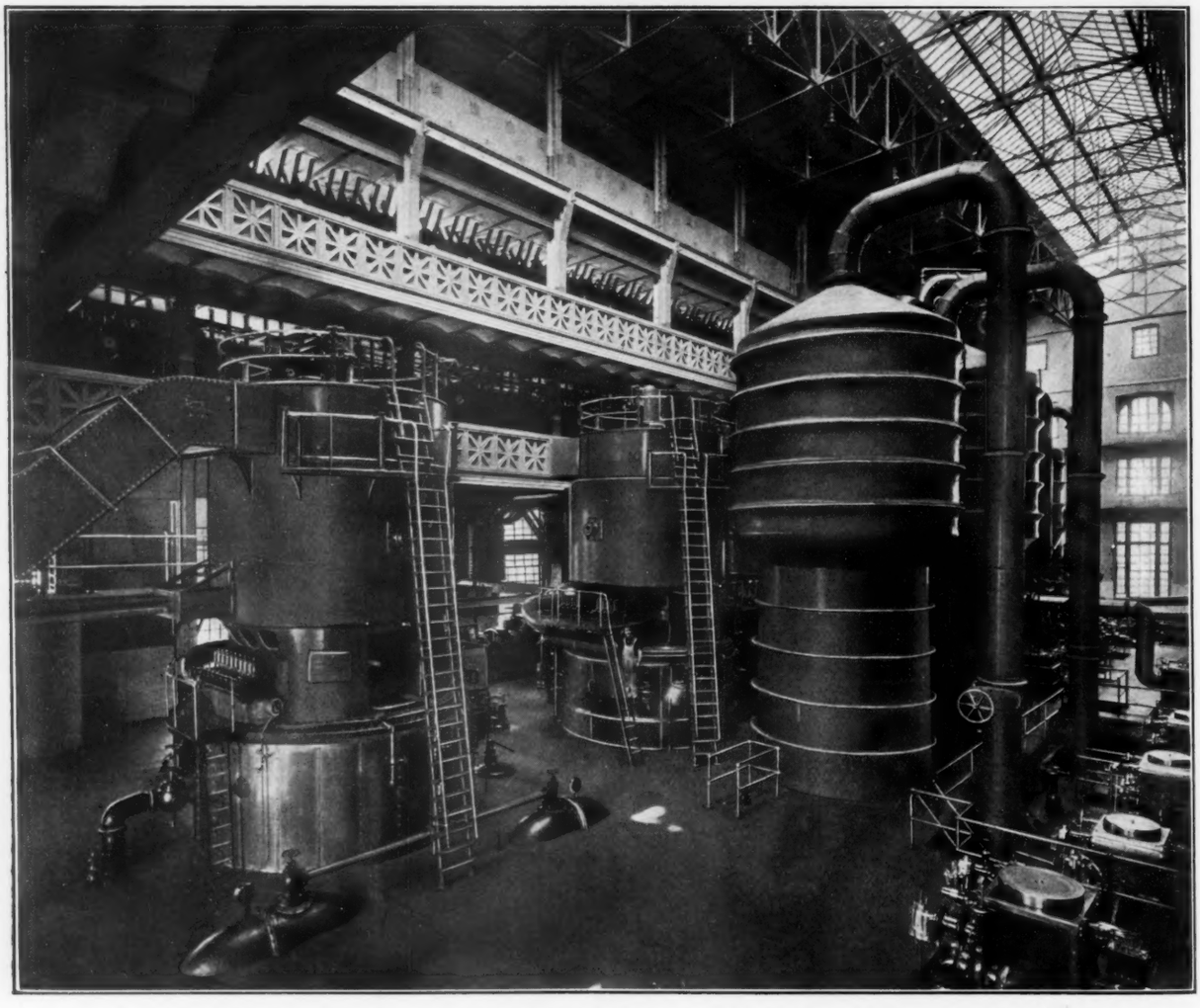


FIG. 3—TURBINE UNITS WITH BAROMETRIC CONDENSERS IN PRESENT CHRISTIAN STREET STATION

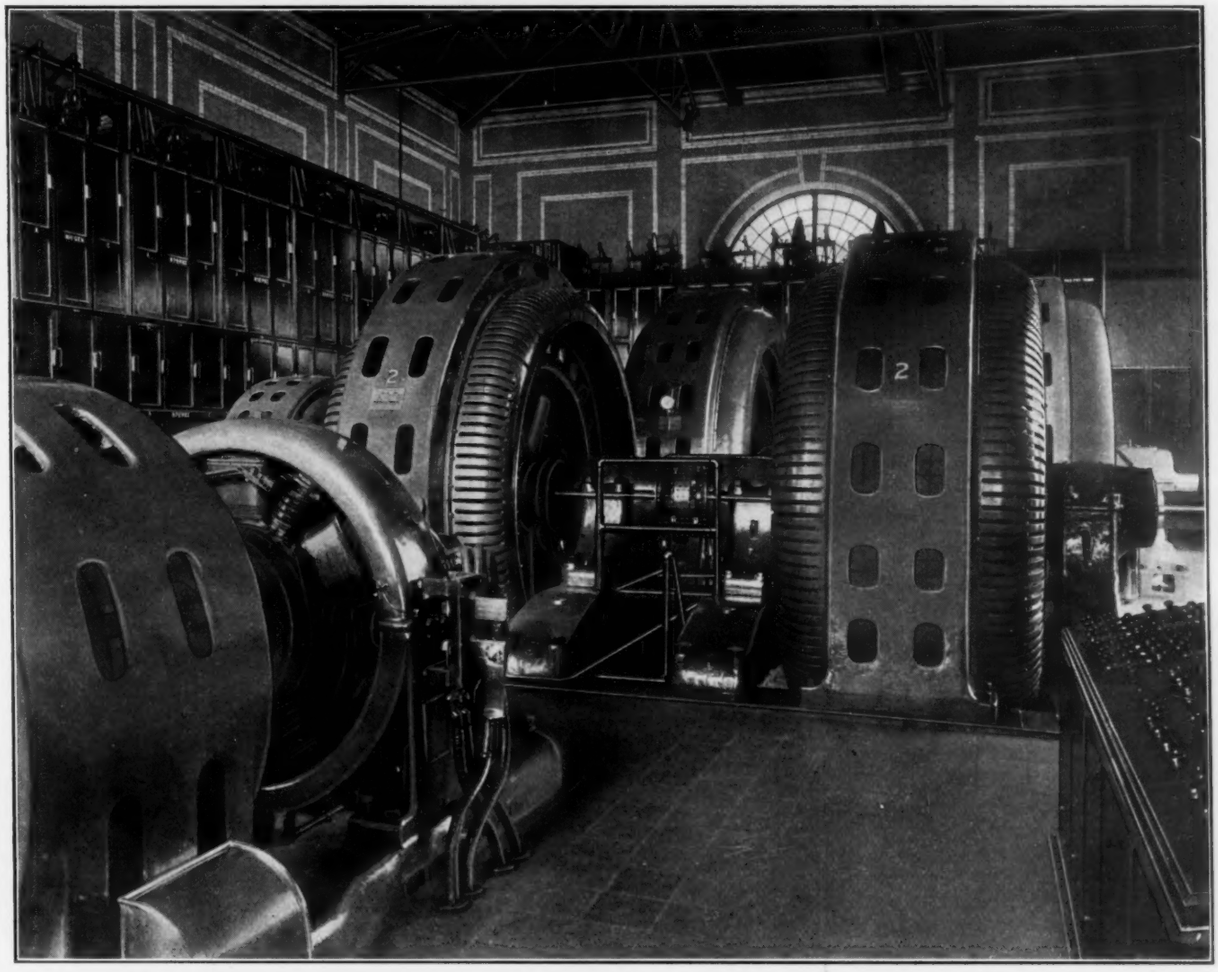


FIG. 4—INTERIOR OF FREQUENCY-CHANGER SUBSTATION SUPPLYING TWENTY-FIVE-CYCLE ENERGY TO RAILWAYS

dustrial railway and system of hoist buckets, which can take its supply either from coal barges on the Schuylkill River or from the tracks of two trunk-line railroads. From the overhead bunkers the fuel is discharged directly to the Taylor underfeed stokers. The present boilers are twenty-four tubes wide and twelve tubes high and are arranged with baffle walls of brick and cast-iron plates. The boilers furnish steam at 200 lb. pressure and 120 deg. Fahr. superheat. The plant is equipped with steam-flow meters, draft gages, efficiency meters, etc.

For the designation of various pipes in the power house the complete color scheme employed is as follows:

	Pipe	Fittings
Turbine step-bearing oil	Red	Black
Oil gravity supply	Yellow	Red
Oil returns	Yellow	Black
Steam lines	Olive green	
Exhaust	Black	
Compressed air	Brown	
Electrical conduit	Blue gray	
Water	Green	

Philadelphia Practice in Bus Layout

In the Christian Street "A-1" station, as well as throughout the system of the Philadelphia Electric Company, duplicate high-tension and exciter buses have been provided, while with the completion of the new "A-2" generating station adjoining the present plant the supply of control energy will be available in triplicate. The duplicate sets of unsectionalized high-tension busbars, which are installed in standard concrete compartments, may be operated singly or together, or also, if desired, separately from different generators, thus giving a flexible bus arrangement.

Throughout the Philadelphia system, it should be noted, all high-tension oil switches, rheostats and auxiliary generator-control equipment are remotely controlled. In the case of certain substations this method of operation is even extended to the control of the oil switches on the outgoing 2400-volt feeder lines.

Generator switches are never made automatic, but a red pilot lamp is arranged with a relay so that the lamp is lighted to indicate overloading. Each phase is provided with a full complement of instruments, including ammeters and voltmeters. All watt-hour meters have their own individual series transformers, which are entirely separate from those serving the relays or other instruments. The outputs of the generating stations are measured by watt-hour meters on the individual generators, no feeders being metered except those supplying station lighting and motor service.

Lamps used for synchronizing are always so connected as to show darkness during the period of synchronism, the rule throughout the system being: "Never throw a switch in the face of a lamp." Each individual generator circuit is provided with its own set of synchronizing lamps in addition to the duplicate standard means of synchronizing provided. Provision is made for "phasing out" feeders after cable repairs.

Experience has shown that inasmuch as all of the feeders carried out of the Christian Street plant are extended underground no lightning-arrester equipment is needed, and none has been installed.

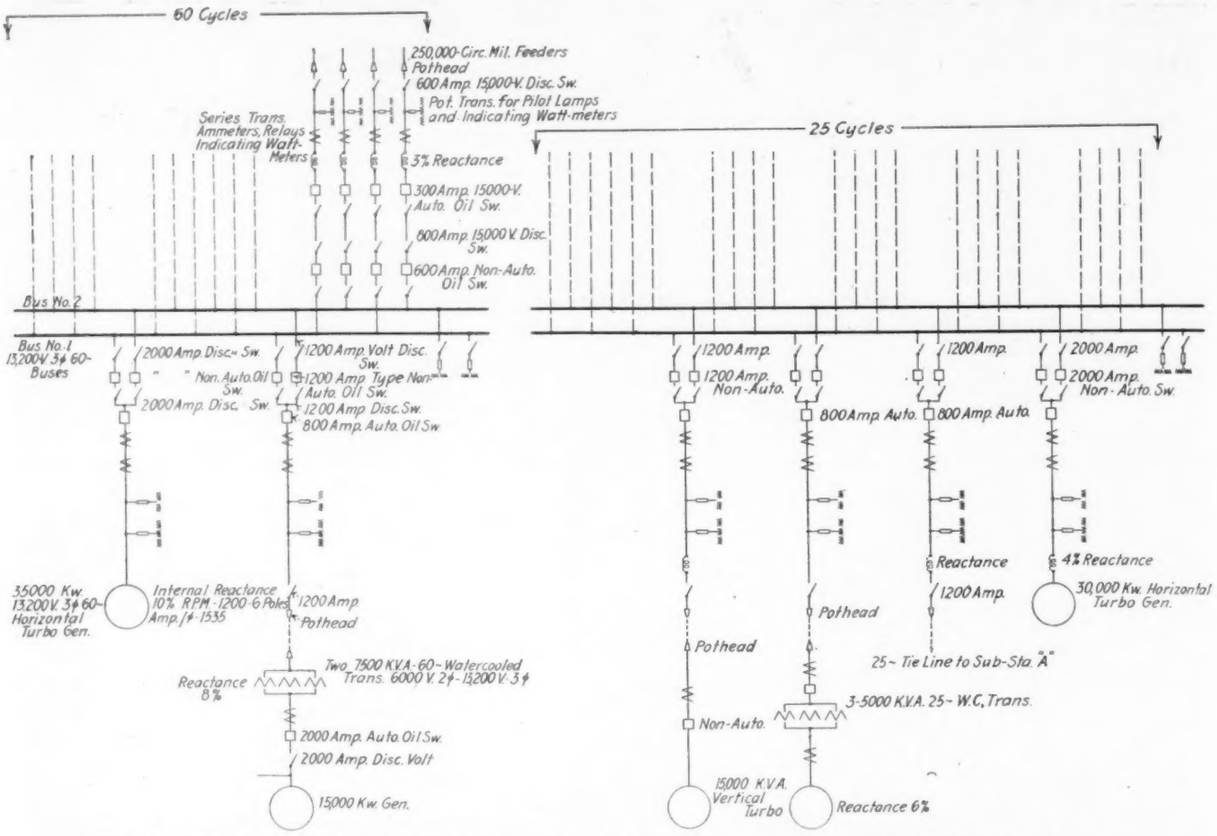

60 Cycles
250,000-Circ. Mil. Feeders
Pothead
600 Amp. 15,000-V. Disc. Sw.
Pot. Trans. for Pilot Lamps and Indicating Watt-meters
Series Trans. Ammeters, Relays Indicating Watt-Meters
3% Reactance
300 Amp. 15000-V. Auto. Oil Sw.
800 Amp. 15000 V. Disc. Sw.
600 Amp. Non-Auto. Oil Sw.
Bus No. 2
Bus No. 1 13,200 V. 3 ϕ 60- Buses
2000 Amp. Disc. Sw.
" " Non. Auto. Oil Sw.
2000 Amp. Disc. Sw.
1200 Amp. Volt Disc. Sw.
1200 Amp. Type Non-Auto. Oil Sw.
1200 Amp. Disc. Sw.
800 Amp. Auto. Oil Sw.
35000 Kw. 13,200 V. 3 ϕ 60- Horizontal Turbo Gen.
Internal Reactance 10% R.P.M.-1200-6 Poles Amp. f-1535
1200 Amp.
Pothead
Reactance 8%
Two 7500 K.V.A.-60-Watercooled Trans. 6000 V. 2 ϕ - 13,200 V. 3 ϕ
2000 Amp. Auto. Oil Sw.
2000 Amp. Disc. Volt
15,000 Kw. Gen.
25 Cycles
1200 Amp.
1200 Amp. Non-Auto.
1200 Amp.
2000 Amp.
2000 Amp. Non-Auto. Sw.
800 Amp. Auto.
800 Amp. Auto.
Reactance
1200 Amp.
4% Reactance
30,000 Kw. Horizontal Turbo Gen.
Pothead
Pothead
25- Tie Line to Sub-Sta. "A"
3-5000 K.V.A. 25- W.C. Trans.
Non-Auto.
15000 K.V.A. Vertical Turbo
Reactance 6%

FIG. 5—CIRCUIT DIAGRAM OF SIXTY-CYCLE AND TWENTY-FIVE-CYCLE BUSES FOR NEW "A-2" STATION

The general grounding practice throughout the Philadelphia system provides separate ground connections for all electrolytic lightning arresters of different voltages, for the neutrals of machines (such grounds being especially designed to carry current in case of emergency), and for the grounding system for the station apparatus. In the last-mentioned ground bus system the buses are laid directly in the concrete of the foundations or compartments, as the case may be. The casing and one side of the secondary of every instrument transformer are also rigidly connected to the station ground bus. Cable sheaths too are solidly grounded.

The various ground connections for the different purposes above described are taken to separate locations in and about the station. Both standard pipe grounds and a special ground box, devised within the company, are employed. In accordance with company practice, pipe grounds must be driven to a minimum depth of 7 ft. and flooded with 4 quarts of saturated salt brine

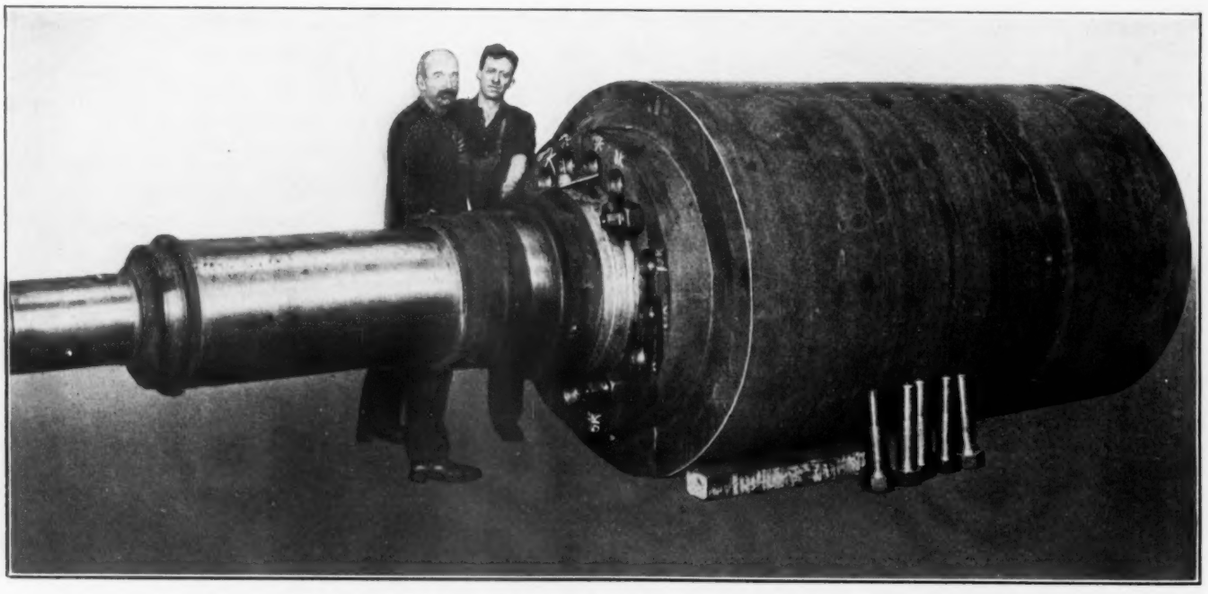


FIG. 6—REVOLVING-FIELD CORE FOR 35,000-KW, SIXTY-CYCLE TURBO-GENERATOR

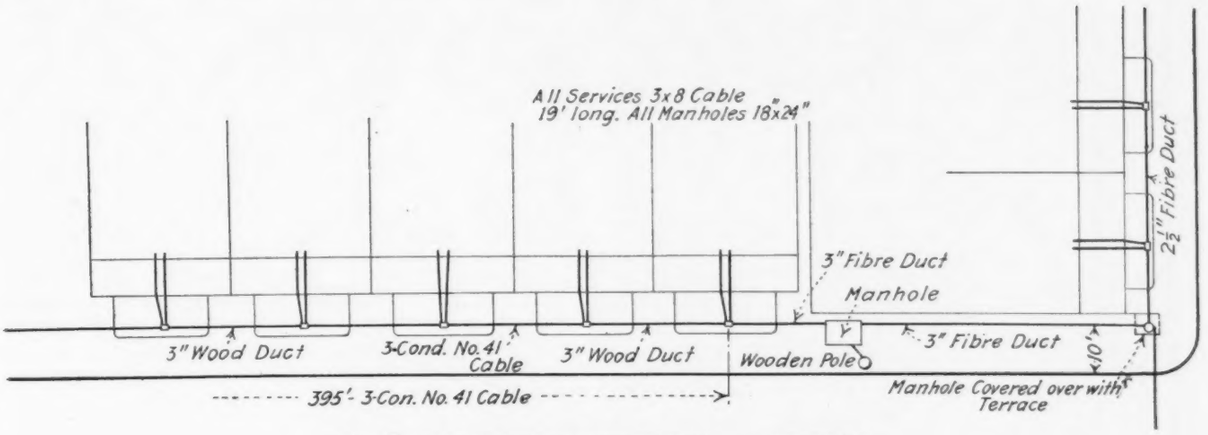


FIG. 7—UNDERGROUND DISTRIBUTION TO DWELLINGS

for each 1½-in. pipe. The ground box above mentioned is made up of a star-shaped casting having openings filled with wire mesh and inclosing a mass of finely divided charcoal mixture of special properties.

Frequency-Changer Substation for Railway Service

On the Christian Street property is also situated Substation "A," a frequency-changer station which was erected in 1911 in the record period of four months to furnish twenty-five-cycle, three-phase energy for the use of the railway company. Its equipment comprises one 6000-kw and one 3000-kw General Electric horizontal four-bearing synchronous motor-generator set arranged with bracket-mounted induction motors for starting. These sets convert 6000-volt, sixty-cycle, two-phase energy into 13,200-volt, twenty-five-cycle, three-phase energy, or vice versa, their twenty-five-cycle output being delivered over underground feeders to substations operated by the Philadelphia Rapid Transit Company. With the transition of the central-station system to three-phase as well as two-phase generation and operation, this substation has thus become a reversible means of tying together the generating systems of the two frequencies. Substation "A" is connected to generating station "A-1" through two tie-lines, each made up of three 2,000,000-circ. mil single-conductor cables.

As shown in an accompanying illustration, the motor-generator sets are of the horizontal four-bearing type. The twenty-five-cycle machines have ten poles and the sixty-cycle machines twenty-four poles, the speed of rotation being 300 r.p.m. To synchronize and parallel such a pair of frequency-changers offers an interesting problem and one to which detailed study has been given by the company engineers. For synchronous indication on the sixty-cycle synchroscope, it may be pointed out, there will be twelve different indications of the twenty-five-cycle pointer, and for the

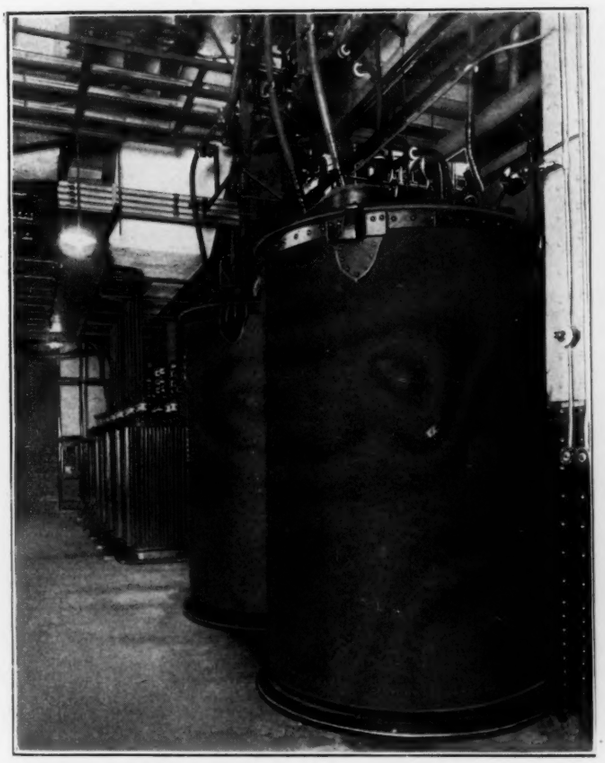


FIG. 8—LARGE SCOTT-CONNECTED TRANSFORMERS FOR TWO-PHASE-THREE-PHASE CONVERSION

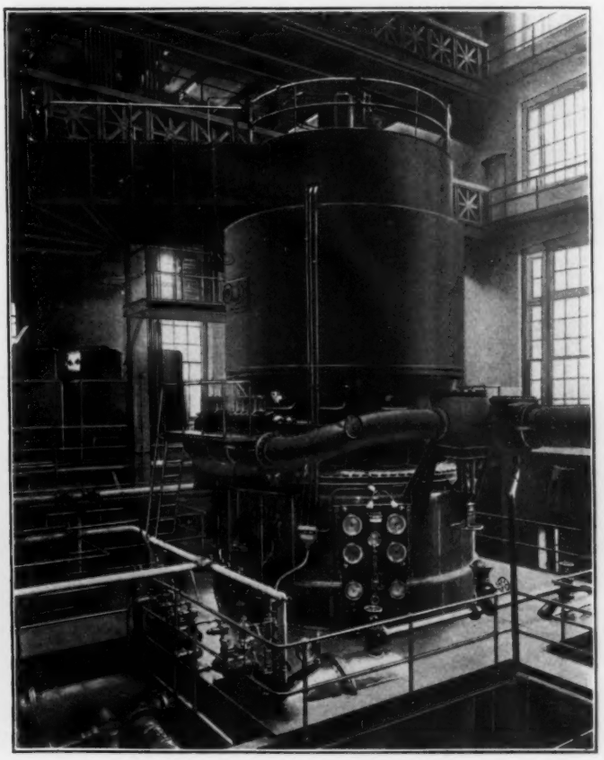


FIG. 9—TURBINE UNIT NO. 6, SHOWING CONTROL EQUIPMENT

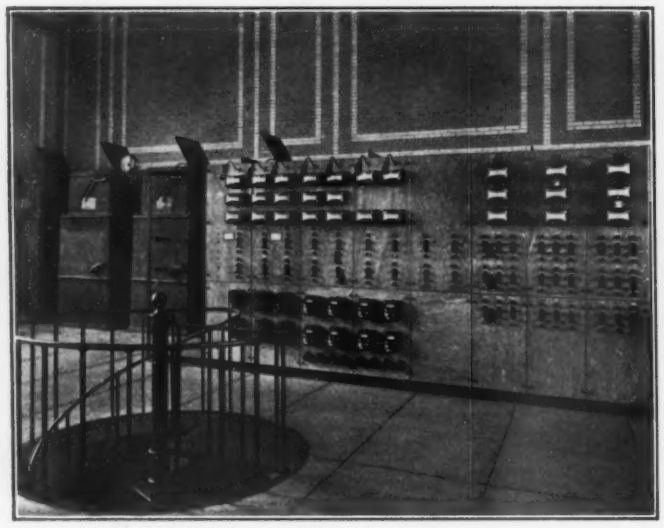


FIG. 10—SUBSTATION "E" SWITCHBOARD AND BANKS OF THREE-TO-TWO-PHASE TRANSFORMERS

position of synchronism on the twenty-five-cycle instrument there will be five positions of the sixty-cycle pointer. Moreover, in paralleling a loaded machine with an unloaded set the latter's switch must be closed with the synchroscope needle out of synchronism by an amount equal to the lag of the loaded machine.

To enable the non-technical operator to perform these functions properly an ingenious method of synchronizing has been devised employing a small cardboard copy of the synchroscope dial over which is mounted a revolving disk. By making the proper settings on this disk computer, which takes into account variation in load, the position of the synchroscope pointer proper for synchronizing under the particular circumstances can be computed with accuracy.

Synchronous-Booster Rotary-Converter Edison Substation

Representative of the best and most modern substation practice of the Philadelphia Electric Company is its new Substation "E," which furnishes both direct and alternating current to the business and residential districts surrounding its location, at Twentieth and Ludlow Streets.

This substation at present receives 6000-volt, sixty-cycle, two-phase energy, but will later operate on 13,200-volt, three-phase supply of the same frequency. This flexibility of operation is provided by the use of

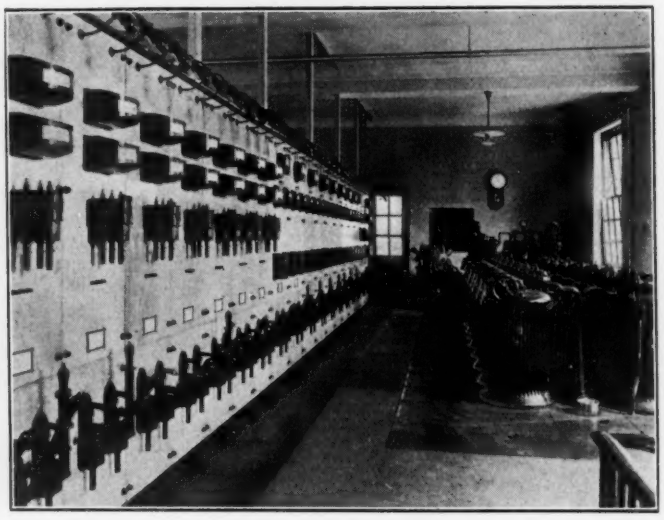


FIG. 12—SWITCHBOARD AND AUTOMATIC REGULATORS IN SUBSTATION "P"

Scott-connected transformers, which will also enable future incoming three-phase energy to be converted into two-phase for distribution, for the continuance of two-phase supply to the motor-generator sets in the adjoining Brush arc-lighting station, "F," and for the rotary-converter equipment feeding the outgoing Edison circuits.

The 110-ft. by 90-ft. steel-and-brick building of Substation "E" also houses a twenty-five-cycle rotary-converter substation operated by the Philadelphia Rapid Transit Company to supply its trolley lines with energy from the electric company's Christian Street generating station.

On the electric company's side the substation equipment comprises two 1500-kw and one 1000-kw Westinghouse sixty-cycle synchronous-booster rotary converters, one 500-kw General Electric three-unit balancer set intended also for battery charging, and two 4000-kw sets of Westinghouse air-blast transformers arranged for three-phase-two-phase conversion. In addition to this apparatus there are now about to be installed two 6000-kva air-blast banks, which will be supplied from the 13,200-volt, three-phase bus and will be used exclusively to furnish two-phase three-wire energy to arc-lighting motor-generator sets in the adjoining substation. Besides their regular 86.6 per cent and 50 per cent taps on the high-tension side, these

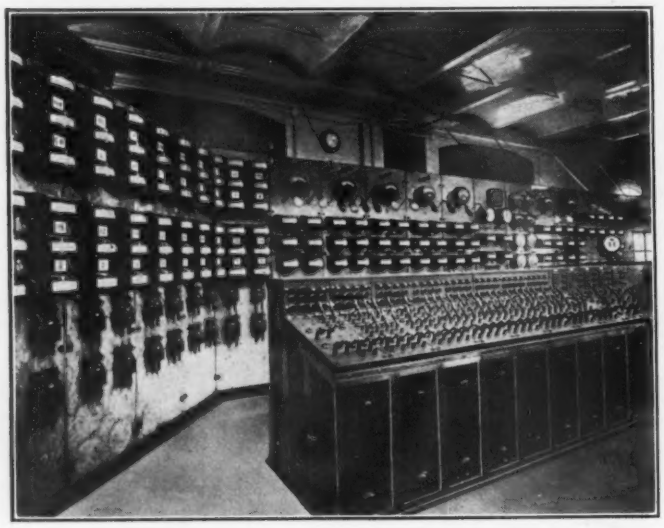


FIG. 11—OPERATING GALLERY, CHRISTIAN STREET STATION

FIG. 13—INTERIOR OF SYNCHRONOUS-BOOSTER, ROTARY-CONVERTER EDISON SUBSTATION

interesting phase-converting units (which are interchangeable as regards "main" and "teaser" relations) are furnished with reduced potential taps on the low-tension side, enabling them to supply two-phase, three-wire synchronous motors of the arc-lighting station. These motors are started at 2400 volts and later thrown over onto the full 5700-volt secondary pressure. Here, as in all the many Scott-transformer connections throughout the system, the main winding invariably preserves the relation of the "A" phase, and the "teaser," of 86.66 per cent winding, is the "C" phase. These air-blast transformers are ventilated under 0.75-ounce air pressure, continuity of operation being assured by an alarm device of local invention which closes contacts and sounds an alarm in event of failure of the air pressure. In the case of the units at Station "E," the air supply comes through a ventilating duct from a fresh-air chamber on the roof and is delivered by duplicate motor-driven blowers. Other air systems are maintained for the rotary-converter transformers, with direct access to the outside air.

The bus structure and oil-switch compartments are of molded concrete with hook-suspended doors of 3/8-in. asbestos lumber, which easily swing outward in the event of any possible explosion. By the scheme of feeder nomenclature used, the origin, destination and voltage rating of any line are clearly defined in addition to its position. Thus "A-347-E" denotes three-phase feeder No. 347 from Station "A" to Substation "E."

For transfer connections on the incoming feeders General Electric remote-controlled selector oil switches are provided in addition to the main 300-amp, 15,000-volt Westinghouse solenoid-operated units. The former are installed in the basement bus structure and the latter on the main machine floor. The latter switches are provided with inverse-time overload control, for which reverse-energy relays of the wattmeter type serve as the sensitive elements, but in the absence of a potential connection to the relay the protection is of the inverse overload character only. Following standard Philadelphia company practice, the casings of all instrument transformers and one side of their secondary circuits are grounded, care being taken that no fuse, cut-out or other interruptive feature is included in the ground circuit. The features of copper ground bus system set in concrete compartment structure have already been touched upon.

FIG. 14—INDUSTRIAL SUBSTATION SUPPLYING CRAMPS' SHIPYARD

Bridged across one of the phases of each feeder line is a potential transformer, the secondary of which is led to a pilot lamp on the switchboard, which illuminates a ground-glass target bearing the feeder designation of the line which is "alive." The current transformers for the watt-hour meters have no other connections than the coils of these meters, which they serve exclusively. An interesting feature lies in the specially designed form of "current-test" cut-out box connected in circuit between current transformer and meter.

The neutral for the Edison three-wire system is taken from a neutral busbar in turn connected respec-

tively to the mid-points of the transformers serving the 1000-kw "three-wire" rotary converter and the neutrals of the three-unit set, and will ultimately be taken to the mid-point of the emergency storage battery when this is installed. The 1000-kw machine with the three-unit motor-generator set is ample to care for any load unbalancing of this station.

Solenoid-operated direct-current circuit-breakers rated at 10,000 amp are in use in the 250-volt outer conductors of the rotary converters. Protection against reverse current flow is afforded by relays of a special rotating armature type, which exert a very positive mechanical action on the tripping mechanism of the breaker and were designed for this installation. The battery leads are brought to the central sections of the board and the outgoing feeders are taken off from the ends. The bus conductors are held in alberene-stone insulating blocks, in turn supported by iron framework. All studs from switches, etc., are inclosed in fiber tubes for safety, and similarly all other parts of live conductors are placed in asbestos-lumber inclosures.

The usual pressure-wire equipment is provided for voltage regulation, pilot wires being run back to the station from centers of distribution.

Transformer and Distributing Substation

Attractive architectural outlines characterize the exteriors of the Philadelphia Electric Company power

FIG. 15—MOTOR-DRIVEN BRUSH ARC-LIGHTING GENERATORS IN STATION "F"

fuse blocks protecting the outgoing direct-current feeders have projecting lugs cast on one side. Into the socket thus formed a contact plug can be slipped, bridging the fuse block and permitting service to continue uninterrupted while the fuse itself is being removed for inspection or repairs.

The Edison direct-current busbars, which are provided in duplicate sets, are mounted at the rear of the direct-current switchboard and are made up of 6-in. by 0.25-in. hard-drawn copper bars, set vertically with 0.25-in. air spaces for ventilation. The number of laminations is graduated so as to be proportional to the load to be carried by the corresponding section of the switchboard. The busbars may be tied together if necessary by large-capacity lever switches of special design placed behind the switchboard. Machine and plants and substation buildings. Emphasis is laid on this feature of pleasing appearance, and the external design of the company's buildings is supervised by one of the leading architects of the city.

In point of dignified design, one of the handsome smaller substations of the system is transformer station "P," at Marshall and Noble Streets, which supplies 2400-volt, two-phase, three-wire, sixty-cycle energy to the industrial district in its vicinity. The incoming polyphase feeders are taken through automatic selector oil-break switches to duplicate sets of high-voltage busbars installed in concrete structures. The use of duplicate sets of busbars housed in permanent concrete structures is characteristic of the high standards of station construction maintained by the Philadelphia central-station company.

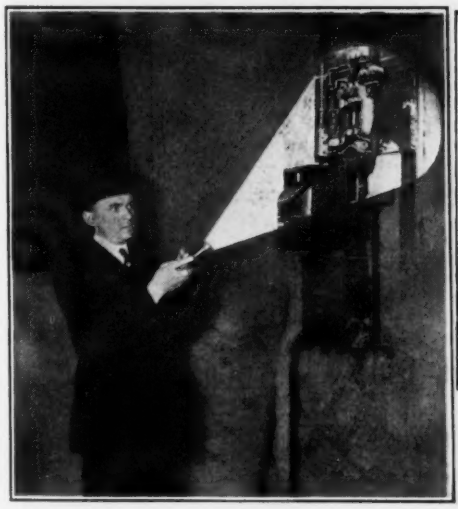


FIG. 16—UNIFORMED METER READER

FIG. 17—LINE CONSTRUCTION TRUCK

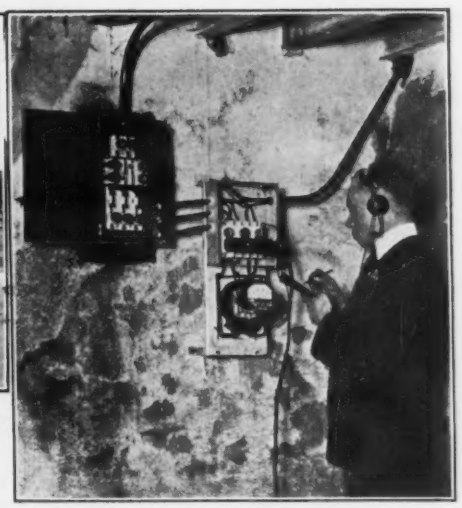


FIG. 18—METER TESTER AT WORK

From the bus-bars lines are taken through automatic oil-switches to the eight 500-kw step-down air-blast transformers which are housed in this station. These units have dial switches on the high-tension side for pressure adjustment, while each of the outgoing 2400-volt, two-phase feeders from the station has its own pair of automatic single-phase induction regulators, the operation of which is controlled through the usual contact-making voltmeter, either in conjunction with a line-drop compensator or according to a prearranged schedule of loads. The regulators are of the General Electric 100-amp and Westinghouse 150-amp types. In addition to the duplicate 2400-volt buses, there is provided a transfer bus connected to the feeder line through a three-pole double-throw oil switch, so that in case of accident to a regulator the corresponding feeder can be energized over the transfer bus from the regulators of some other circuit. The output of the station is metered only on the low-tension side of the transformer. All lines entering and leaving the substation are underground in accordance with progressive practice.

Adjoining the substation is the operator's dwelling, the upper floor of which opens on to the substation roof, where a thriving garden, with vine-covered arbors, hedges and flower boxes, is under cultivation by the station operator. While this is perhaps the only instance where a substation covering supports such a roof garden, the idea of growing trees and grass around the stations of the system is characteristic of the Philadelphia company, by which effort is made to have plant properties as attractive as possible, since it has been found that such beauty has utilitarian value in raising the esprit of the operating staff and inculcating pride in the upkeep of equipment.

Transmission and Distribution Line Construction

For the overhead lines of the Philadelphia system only the best selected chestnut poles are used, and these are purchased under specifications even more rigid than the Class A requirements of the National Electric Light Association. Most of the poles used are 45 ft. and 50 ft. long, and they must measure at least 8 in. in minimum diameter at the top. Stocks are where possible so purchased that poles may lie in the yard about twelve months.

Before being erected the poles receive a brush treatment 2 ft. above and below the ground line with Avenarius carbolineum. Yellow-pine 3.25-in. by 4.25-in. cross-arms are employed exclusively. All service runs are dropped from double arms, no iron arms or spreader brackets being used. For cutting arc-lamp loops into

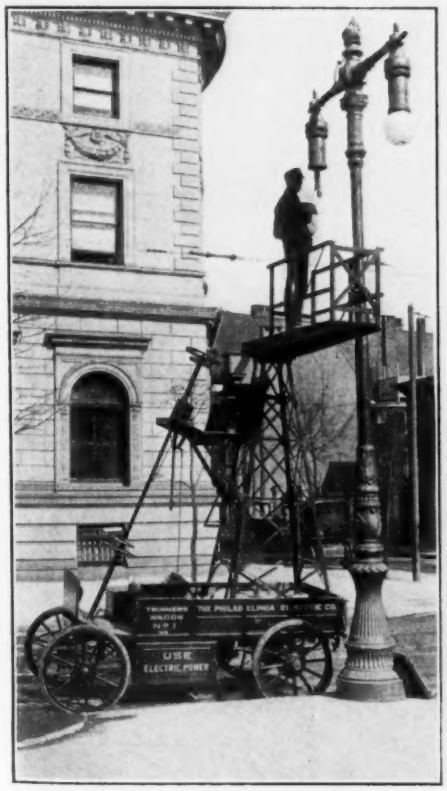


FIG. 19—LAMP-TRIMMERS' TOWER WAGON "ON THE JOB"

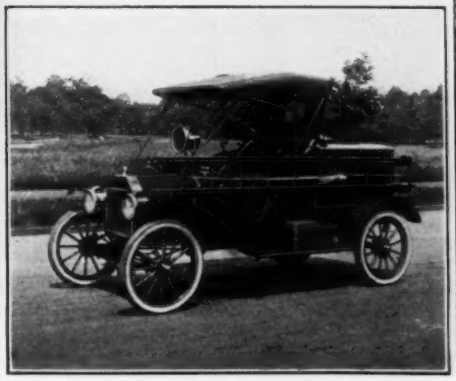


FIG. 20—LIGHT REPAIR WAGON OF OVERHEAD-LINE DEPARTMENT

FIG. 21—WAGON BEING DRIVEN BY STORAGE BATTERY

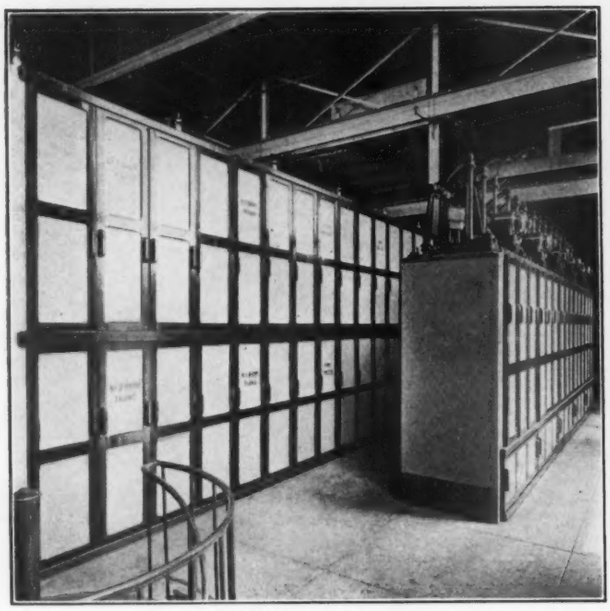


FIG. 22—MAIN AND SELECTOR 13,000-VOLT OIL-SWITCH COMPARTMENT, SUBSTATION B

FIG. 24—CABLE VAULT BENEATH ARC-LIGHTING SWITCHBOARD

series circuits transposition insulators are employed, the extra grooves being utilized for tying together and equalizing the strains of the two unbalanced spans.

On poles carrying several three-phase circuits the arrangement is such as to permit the lineman to reach and work on the top wires without endangering himself by coming in contact with the lower circuits.

According to the present practice of the Philadelphia company, transformers are never banked. Branch lines from a given feeder main are always protected by pole switches which facilitate the location and isolation of trouble. Transformers are invariably fused on the primary side and never on their secondary side. The 50-kw size is being standardized as the unit, although the territory supplied by such a transformer varies, of course, inversely as the density, ranging from one block or less in closely built sections to three and four blocks in the suburbs. Lighting and motor services are fed from separate secondary circuits wherever possible, although both classes of lines are kept under close voltage control by automatic feeder regulators installed in the substation and inserted in every line.

A feature of Philadelphia distribution practice has been the method of supplying 220/110-volt, three-wire service to rows of dwellings. Three-pin brackets are affixed to the rear of the houses about the second-story level, and on these are strung the main lines. Thence service taps are run through conduit to the basement, where the company's circuit ends at the inclosed cut-out and meter board.

In West Philadelphia several blocks of residences are already fed underground from manhole transformers energized from nearby poles. The secondary mains are run in fiber-duct conduit laid 24 in. below the surface,

FIG. 23—INDUSTRIAL SUBSTATION, AMERICAN VISCOSE COMPANY

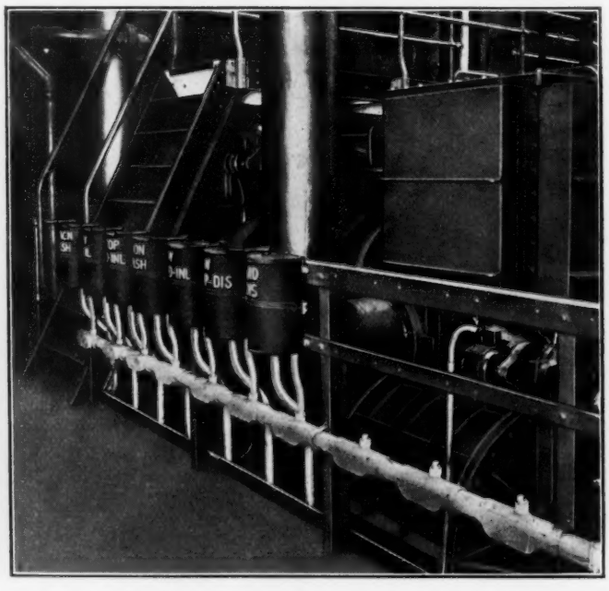


FIG. 25—CONTROLLERS FOR MOTOR-OPERATED VALVES OF SURFACE CONDENSER ON UNIT NO. 6

GRIPPER SIDE GUIDE

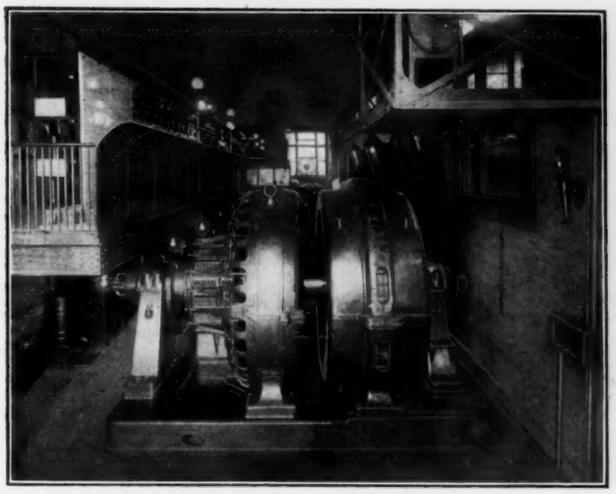


FIG. 26—MOTOR-GENERATOR SETS IN SUBSTATION "Q"

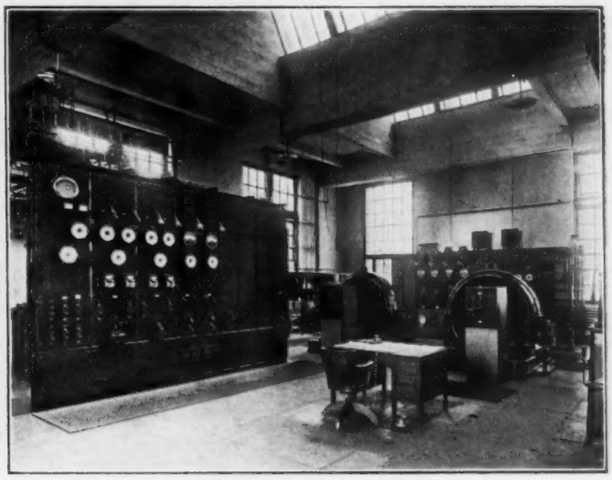


FIG. 28—INTERIOR OF FOLSOM SUBSTATION

and house taps are taken off through wooden junction boxes.

One of the unique vehicles in the service of the line-construction department is a special 6-ton electric truck with a 20-ft. wheelbase, used for transporting poles. The truck measures 31 ft. 6 in. over all and can haul poles up to 90 ft. in length. Each of the four wheels is separately motor-driven, and by steering with both the front and rear wheels the truck can be turned in a radius of 18 ft.

Fully loaded the normal speed is 7 miles per hour, and the forty-two-cell "Exide" batteries have a capacity equivalent to 30 miles of truck travel. Midway of the truck body is a small motor-driven winch which can be used to load and to erect poles. The wagon described was built for the Philadelphia Electric Company by the Commercial Truck Company.

Electric vehicles are largely used as line-construction and repair wagons, replacing horse-drawn teams. Formerly a number of motorcycles were employed for emergency repair work, but these are now being replaced by light four-wheeled gasoline vehicles which are equipped with search-lanterns, extension ladders, fuses, wire and all material necessary to make quick repairs. These vehicles are stationed at various points in the city, under call of the trouble foreman.

Philadelphia's System of Street Lighting

Philadelphia was one of the first cities to adopt arc lamps for street illumination. In the year 1882 the Brush Electric Light Company supplied energy to forty-nine lamps on Chestnut Street, under a special ordinance of Councils, free of charge for one year, to demonstrate the practicability of this form of illumina-

FIG. 27—FEEDER SUPPLYING SUBURBAN RESIDENCE AND STAINED-GLASS STUDIOS

FIG. 29—ELECTRIC POLE TRUCK IN THE POLE YARD

tion, and since that time Philadelphia has been notable for the general excellence of its street lighting over an area of 129 sq. miles. There are now in use over 14,530 arc lamps.

The first lamps used were of the Brush double-pencil carbon type. These lamps had some mechanical defects. On account of rapid development and demand the company was forced to make improvements in the lamps in order to maintain reliable service. This necessitated the equipping of a shop and laboratory to build arc lamps required for extensions and to remodel the older types of lamps. Every new type of lamp worthy of commercial consideration has been tested first in this laboratory and then on the streets, so that this department has kept step with the progress of the art. It has been the policy of the company to test all possible improvements. A few of the types tested were the inclosed, magnetite, flaming, mercury, and finally the nitrogen-filled lamps, this company being the first to erect series nitrogen lamps for street illumination.

Many previous attempts had been made to build a successful broad-carbon lamp, but the engineers of this company were the first to develop a practical lamp of this type. The advantage of the broad-carbon lamp, which was early recognized, was the longer life of the electrodes and consequent reduction in the number of trims. Its chief disadvantage was the serious shadow cast by the lower electrode. In the improved design brought out by the company this disadvantage was eliminated by using an upper electrode of double the thickness of the lower electrode. Both electrodes are 5 in. wide and 8 in. long, the upper electrode being ⅝ in. and the lower carbon 5/16 in. in thickness. The lower electrode always presents a knife edge to the arc, practically eliminating the shadow. The thickness of the upper electrode causes a wider crater and makes an excellent reflector to distribute the light in the lower hemisphere. The stumps from these large electrodes are then sawed to a width of 3 in., pointed at the end and are ready for use in the "pony" broad-electrode lamps, enabling practically the complete consumption of the electrodes. The mechanism of the lamp had to be specially designed on account of the greater weight of the electrode and some varying characteristics. Use is made of a special globe that is self-cleaning.

The lamps are hung with the edge of the electrodes toward the pole, thereby eliminating shadows up and down the street. They are adjusted for 9.6 amp and consume 480 watts per lamp. The life of the electrodes is eighty hours per trim.

Method of Mounting

In the central section of the city the lamps are mounted on ornamental bronze, double-arm posts, placed on the curb and on certain streets, also in the middle of the street on isles of safety. These lamps are known as the "pony" type and utilize the carbon stumps from the standard broad-electrode lamp, their life being

FIG. 30—REAR-BRACKET CONSTRUCTION SERVING ROW OF DWELLINGS

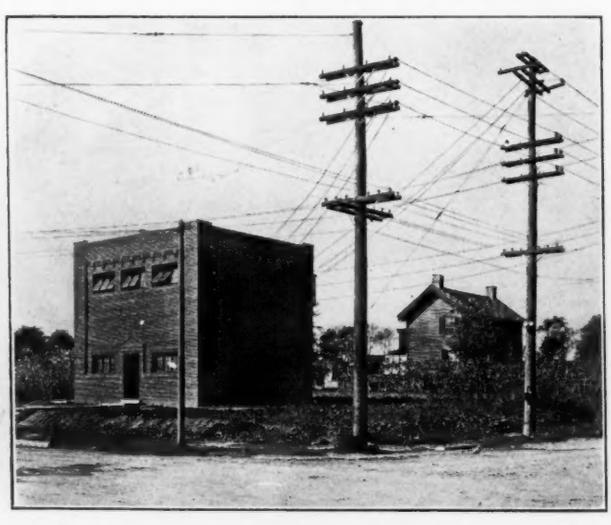


FIG. 31—LIGHTNING-ARRESTER HOUSE AT UNDERGROUND-OVERHEAD JUNCTION NEAR TACONY

somewhat over thirty hours. The total life of a pair of electrodes is thus about 110 hours to 120 hours. The standard broad-electrode lamps are used in the outlying sections of the city, and the "pony" type in the central section.

Of the many details in connection with the maintenance and operation of this large number of street lamps which are novel and have been developed in Philadelphia, mention might be made of the system of trimming and inspecting, which includes the use of special electrically operated tower wagons, the distribution of supplies and the methods of keeping records.

At present experiments are being made with the series-type nitrogen-filled lamp for street lighting. These tests were started about a year ago and very satisfactory results have been obtained. All of the newer types of nitrogen-filled lamps are now in operation.

FIG. 33—EXTERIOR OF TRANSFORMER STATION "P"

Motor-Driven Arc-Lighting Generators

What is undoubtedly the largest and most recent Brush-generator station in the world is that supplying energy to the downtown street-lighting circuits of Philadelphia. This interesting substation contains thirty-eight three-unit sets, each comprising a 150-hp, 5500-volt, sixty-cycle, two-phase, three-wire synchronous motor driving through rubber insulating couplings a pair of 120-lamp, 9.6-amp, 6250-volt Brush arc-lighting generators. Excitation for the motors is obtained from the Edison system.

These 5500-volt motors are started with open-field circuits from 2400-volt taps on the windings of the large T-connected transformers in the adjoining substation "E," being afterward thrown to full-pressure running connections. An original arrangement of mechanical interlocks has been devised for the "starting" and "running" switches of each synchronous motor, which positively prevents the two voltages from being brought together. Mounted above the frame of each machine is a pilot lamp which is lighted when the corresponding unit is in service. Inclosing globes of different design are used on the motors and arc generators, so that the attendant may see at a glance what machines are in operation.

An elaborate arc-lighting switchboard permits the interconnection of various machines and lamp circuits by the use of plugs without jumpers. A portable test set which can be rolled along the front of the board enables the current flowing in any line to be read without disturbing the lamps in use. In the substation office there is maintained a complete card catalog showing every lamp fed from the sta-

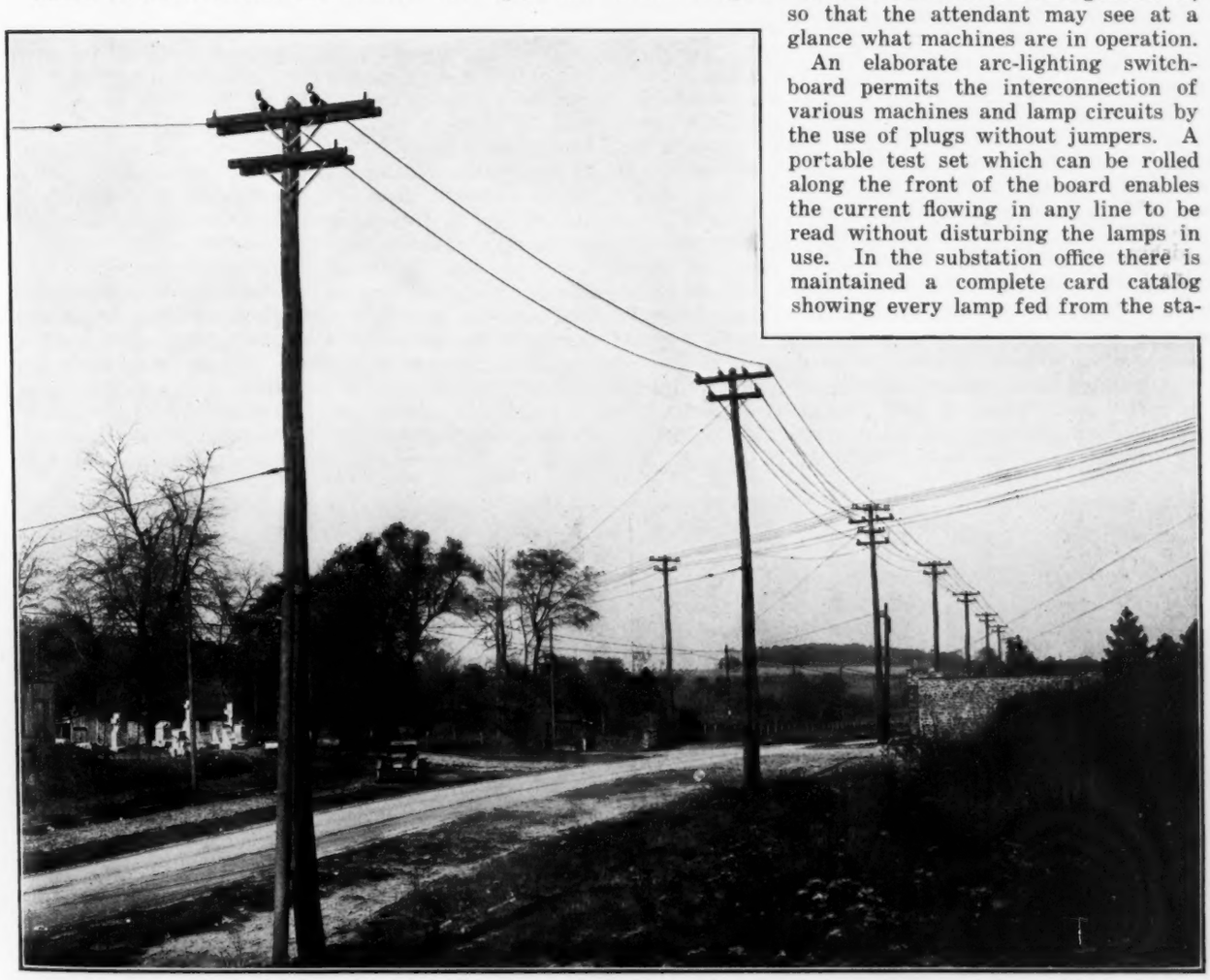


FIG. 32—DOUBLE-CIRCUIT POLE-LINE CONSTRUCTION AND METHOD OF DEAD-ENDING

tion. The cards are filed in racks corresponding to the respective circuits, so that in case of trouble the lamp involved can be located quickly. In the basement are the lamp-circuit feeder cables, which are laid up neatly in racks along the whitened walls, while the connecting lines which appear as vertical drops are tapped onto them without unsymmetrical crosses, the whole making a most flexible arrangement. The synchronous motors of these many motor-generator sets are also used to advantage for power-factor correction during the summer months.

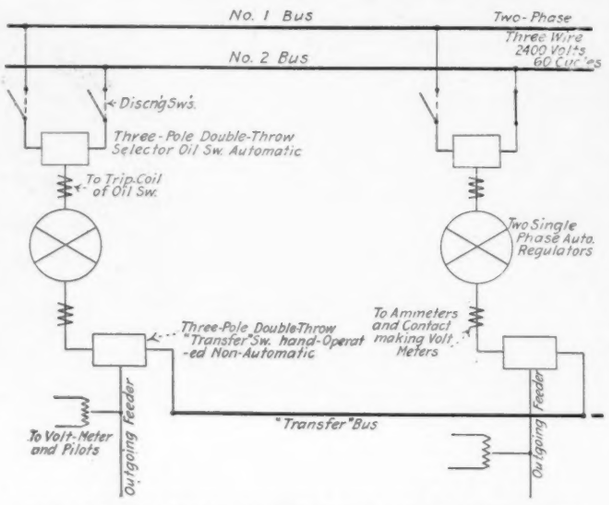

No. 1 Bus
Two-Phase Three-Wire 2400 Volts 60 Cycles
No. 2 Bus
Disc'ng Sw's.
Three-Pole Double-Throw Selector Oil Sw. Automatic
To Trip Coil of Oil Sw.
Two Single Phase Auto. Regulators
To Ammeters and Contact making Volt. Meters
Three-Pole Double-Throw "Transfer" Sw. hand-Operated Non-Automatic
"Transfer" Bus
To Volt-Meter and Pilots
Outgoing Feeder
Outgoing Feeder

FIG. 34—DIAGRAM SHOWING USE OF TRANSFER BUS

Energy Supply to Railways

Exemplifying in fact the central-station idea of centralized energy production, it is interesting to note that approximately one-third of the output of the Philadelphia Electric Company is now sold to the local street-railway company, which in this way obtains about 40 per cent of its present total energy requirements. The Pennsylvania Railroad has also contracted with the electric company for the supply of power to operate its lines now being electrified in the vicinity of Philadelphia.

The Philadelphia Rapid Transit Company, which operates both city and suburban car lines in the district reached by the Philadelphia Electric Company, now purchases about 27,000 kw from the central-station system, taking this energy at a load-factor of about 36 per cent. This energy is metered and sold at transmission potential, the railway company in general furnishing and operating its own transformer and converting equipment. An exception, however, is the northern district, where the central station company has installed its apparatus in existing plants of the railway company. On this system a number of sixty-cycle rotary converters are in satisfactory operation.

The electrification plans of the Pennsylvania Railroad on which work is already actually under way call for the immediate single-phase electrification of its "main line" from the Broad Street station to Paoli, Pa., 20 miles distant, to be followed by the electrification of the Chestnut Hill branch. Under the terms of the contract an initial minimum of 3750 kw of single-phase, twenty-five-cycle power will be required beginning with the fall of 1914. The railroad company will erect a substation adjoining the Christian Street generating plant and will operate its own distribution equipment from that point.

With the extension of the electrification, three-phase energy will be taken, although special provision will be made for variations in load on any leg of the circuit.

Commercial Organization

For the work of the commercial department the territory to which service is supplied by the Philadelphia Electric Company is divided into a number of districts each in charge of a district manager who has his own staff of salesmen. The head of the commercial department is the general agent, and directly under him are divisions which specialize on motor services above 10 hp, electric vehicles, sign lighting, refrigeration and similar work.

Of particular interest is the large growth of the company's motor load during the last few years, and especially during 1913 and the elapsed months of the present year. For 1913 the increase in contracted commercial motor load was 15,000 kw, representing about one-half of the total new business added to the company's lines. This increase is at least four times the rate of growth enjoyed by the company ten years before, when its motor service was a relatively smaller proportion of its total business. By the close of 1914 it is expected that the Philadelphia system will have a total connected load of over 200,000 kw, which is at least double the corresponding figure for 1909, five years ago.

Among the large motor loads recently acquired is the 2000-hp installation of the Girard Point grain elevators of the Pennsylvania Railroad, the largest grain-storage establishment in the world. The elevators, conveyors, loaders, etc., are all operated by electric

FIG. 35—BANKS OF FEEDER REGULATORS, SUBSTATION "O"

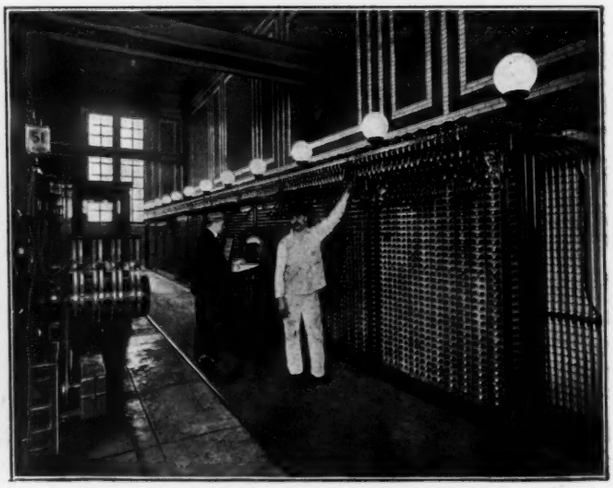


FIG. 36—ARC-LIGHTING SWITCHBOARD

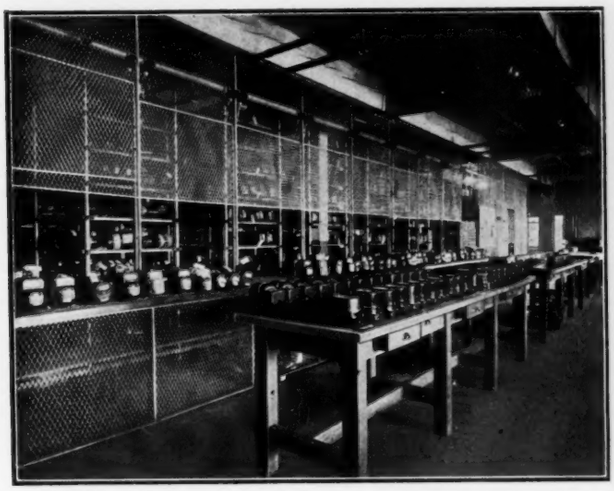


FIG. 37—METER STOREROOM, METER DEPARTMENT

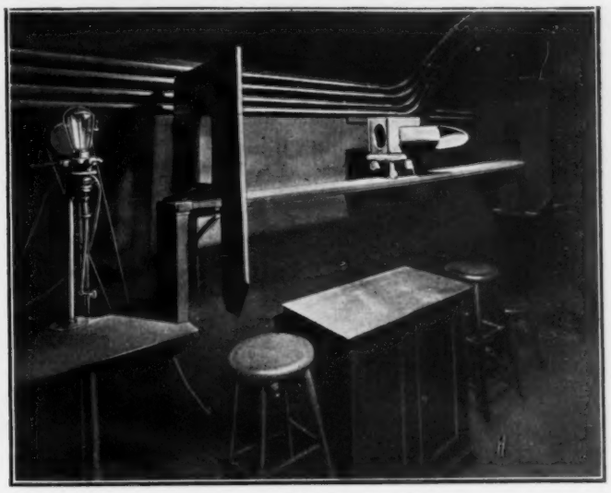


FIG. 39—PHOTOMETER ROOM OF COMMERCIAL DEPARTMENT

motors. Other large motor users served by the company are:

	Hp.
American Viscose Company	1,800
Cramp Ship & Engine Building Company	1,606
Gimbel Brothers	1,600
Philadelphia *Evening Bulletin*	1,500
Pennsylvania Salt Manufacturing Company	1,200
Adams Express Company	1,000
Bell Telephone Company of Philadelphia	1,000
Philadelphia *Inquirer*	1,000
Aberfoyle Manufacturing Company	925
J. G. Brill & Company	800
Chester Paper Company	800
Erben-Harding Company	800
Post office pneumatic tube service	703
Hale & Kilburn	625
Lit Brothers	625
Cresson-Morris Company	500
Standard Roller Bearing Company	500
J. T. Lewis & Company	500

The load requirements of such large consumers usually make necessary the supply of energy at transmission pressure direct to the customer's premises, where a special substation is installed for stepping down the voltage for distribution in the plant. In many cases rotating machines must also be operated to provide direct current. The design of these industrial substations has been a feature of the work of the engineering staff at Philadelphia. In general the simplest possible construction is provided, and every means is taken to insure the safety of the non-technical operator who is usually employed by the customer. In these stations, as elsewhere on the system, the three-meter method of wattmeter connection is employed, the meters being installed preferably on the high-tension side of the transformers where the substation is operated by the customer. When utilizing a room in an existing building, the compartment is usually rendered as nearly fireproof as possible by laying a concrete floor and installing a metal or asbestos-covered ceiling.

Lighting Service

At its main office, corner of Tenth and Chestnut Streets, the Philadelphia Electric Company maintains a handsomely appointed display room. The exhibit on the street floor includes ornamental lamps, heating appliances, etc., and elaborate show-window displays of miscellaneous electrical apparatus. Courteous attendants are on hand to give information, and at the rear of the display room is the cashier's office, so that customers entering to pay bills pass the appliance exhibits.

In the basement is a very complete working exhibit of larger electrical appliances, including motor applications, lighting units and light sources, etc. The commercial department also has here its own complete photometer room, where illumination tests can be conducted for the benefit of customers.

The headquarters of the electric-sign division exhibits a number of illuminated electrical displays. Scat-

FIG. 38—OFFICE OF MEDICAL DIRECTOR, MAIN BUILDING

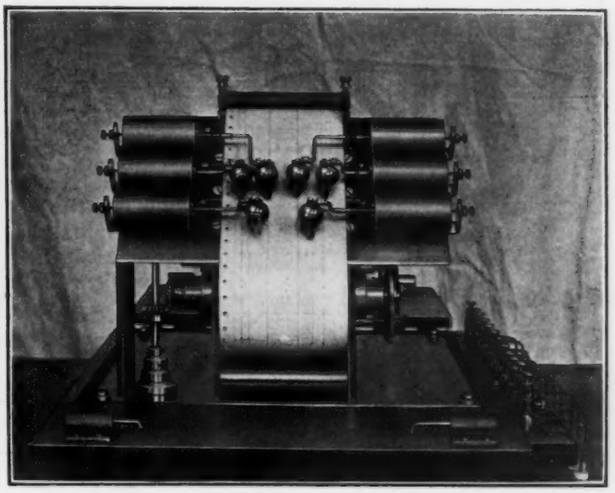


FIG. 40—"ERROMETER" FOR RECORDING METER TESTS

tered over its great area, Philadelphia has one of the largest electric-sign loads in the country. At the present time more than 5000 signs are in operation, representing a connected load of 3100 kw, or 200,000 lamps.

To customers, architects and engineers consulting illuminating-engineering service is offered gratis, trained engineers being retained to design installations, prepare plans, etc.

Wiring of Existing Residences

The company does not do wiring but co-operates with local electrical contractors. To owners of existing unwired residences it offers the benefits of its deferred-payment plan. If the prospective customer prefers not to pay outright for the cost of wiring, the company will secure estimates from several local contractors and submit these for the choice of the customer. When the job is completed the company pays the contractor outright, reimbursing itself in twenty-four monthly instalments collected from the customer with his lighting bills. This deferred-payment offer, of course, covers only the wiring and does not include the fixtures, which must be paid for separately.

As soon as the contract for service is signed the new customer receives a letter from the company the purpose of which is to put the customer in a friendly attitude by showing him that the company stands ready to render various services besides those stipulated in the contract. In part this letter reads as follows:

"It is the earnest desire of this company that none of its customers shall use one kilowatt-hour of electricity more than is absolutely required for proper illumination or efficient motor service. To assist you in these matters we place at your disposal, free of charge, our commercial inspection departments, which are prepared to give you practical advice and suggestions tending to make your lighting or motor installation, as the case may be, one of the highest efficiency.

"We hope you will feel free to call upon us for information regarding anything in connection with the purchase of electricity or the use of the same, so that the cordial relations which we endeavor to maintain with all of our customers will find no exception in your case.

"We inclose a partial list of the various electrical appliances making for economy and convenience in the home or business office. It will be of advantage to you to file this list where you can readily refer to it."

FIG. 41—INTERIOR OF MAIN SHOWROOM, GENERAL OFFICE BUILDING

Besides the usual varied characteristic lighting services, the Philadelphia company has on its lines an unusual proportion of the available church-lighting installations of the city, which it obtained as the result of a recent campaign in this direction.

Graphitized-filament lamps and the few remaining carbon lamps in use are granted free renewals, as are also all tungsten lamps in sizes above 100 watts. For the smaller tungsten sizes a nominal charge is made, which for units below 25 watts rating is the same as the first installation charge. Identification cards are given to customers for use when exchanging lamps, and on these are entered records of the renewals made.

These cards also serve to designate the proper voltage of the lamps to be furnished the customer, since in accordance with the company's engineering practice a constant bus voltage is maintained at substation busbars, the pressure at customers' premises being in-

FIG. 42—APPLIANCE SHOWROOM, GERMANTOWN OFFICE

versely proportional to the respective distances from the distributing centers.

Publicity and Advertising

For coining the familiar slogan "If it isn't electric it isn't modern," since adopted widely elsewhere, the Philadelphia Electric Company takes credit. This motto is reproduced in window displays and exhibit rooms and on the battery boxes of various electric vehicles and trucks used by the company.

The company makes extensive use of newspaper, program and street-car advertising and of electric signs. It also issues quarterly to its customers an attractive and well-printed twenty-eight-page *Bulletin*, in which are presented interesting general and local electrical news and commercial material. A number of useful booklets have been prepared and widely circulated on household uses of electricity, special lighting applications, etc. These have attracted wide attention and several have already been adopted for national circulation. Folders are inserted with customers' monthly bills. The advertising department also has a lecture bureau, which is prepared to furnish speakers on household electrical topics before women's clubs, social meetings, etc.

Testing of Customers' Meters

The meter department alone employs 350 men, including installers, testers, readers, computers, etc., and has charge of 62,000 watt-hour meters. Of the latter number about 9000 are direct-current meters and the remainder are of the alternating-current type. The department has a completely equipped laboratory occupying four stories of a modern building at 226 South Eleventh Street, the remainder of the building being devoted to other divisions of the meter department.

On their receipt from the manufacturers all meters first receive the usual laboratory inspection and routine test before being placed in stock. Then, after having been installed on the customer's premises, they again have a thorough test, usually within ten days of the time of installing and always before taking the reading for the first bill. Forty testers are employed. In the routine of tests made use of these men are about equally divided, half employing the rotating-standard scheme of test, while the other group check the meter under test against calibrated indicating instruments.

For rotating-standard tests the "eye-and-ear" method, which was originated in Philadelphia, is used exclusively. At each revolution the shaft of the standard meter makes a contact which produces a click in a head telephone, so that while the operator watches the rotation of the tested meter he can check it by sound against the speed of the rotating standard. This permits very close accuracy in comparing rotation speeds and saves much time for the tester.

The "errometer" for comparing the accuracy of different test methods was also devised locally. In this apparatus a paper strip about 4 in. wide is fed by clockwork under six styluses each actuated by an electromagnet which when energized makes a slight "jog" in the corresponding line drawn on the paper. One stylus is included in the circuit from the laboratory clock, a second is controlled by the rotating standard meter, and the others are connected to the meters under test. From a study of the records resulting the accuracy of any method, as well as the skill of the tester, can be determined definitely.

For making alternating-current meter tests at partial power factors a leading potential is employed instead of a lagging current. This reversal of the more common practice results in a considerable reduction of the apparatus necessary for such tests.

Meter testers for the Philadelphia company are recruited from colleges, high schools, trade schools, etc., and are first assigned to work as assistants to the regular testers for periods of one year or eighteen months. Next they are put through practical courses of instruction, which include making repairs in the shop, assembling meters, cleaning parts, etc. After three months of this work the new man takes up his duties as a regular tester, an experienced instructor acting as his assistant for a week or two. When finally declared proficient the graduate is sent out on the simpler jobs as a regular tester, and from time to time he is steadily advanced to special and complaint work. For greater accuracy the results obtained by these testers are occasionally checked without their knowledge either before or after the regular test. The division foreman also drops in unexpectedly at places where his men are at work, visiting each man in this way at least once a month.

In case a meter is found to be in need of repairs no

FIG. 43—PERMANENT OPERATING EXHIBIT OF LARGER APPLIANCES

delay is permitted to occur before taking steps to put it into shape. The tester at once summons a repairman and even waits at the place if necessary until the proper repairs are made. In the case of laboratory repairs the shop is so arranged that an experienced

repairman occupies a central bench while the learners work at benches alongside their instructor.

Each meter is designated by an aluminum clip bearing a serial number which also indicates the kind and size of the instrument. The history of each meter on the system is entered on a record card which shows on one side the various locations where the meter has been installed, dates, etc., and on the other the dates of tests, results, etc. All correspondence relating to each customer's meter is also filed in an envelope and deposited in the general meter file.

In addition to the initial laboratory and installation tests before described, each meter also receives routine tests at regular and frequent intervals which range from several months to a year, depending on the type of the instrument.

Meter Installation and Reading Routine

The staff of meter readers numbers twenty-five. These men are all in uniform and follow regular routes over the twenty-four districts into which the system is divided. In this way these inspectors are reading meters practically every weekday of the month, except for two or three days near the close of the month when missed readings are caught up. From month to month the men are assigned to entirely different routes, so that a given inspector will not read the same meter oftener than once a year.

Both a meter record card and customer's record sheet are made out for each customer's meter. The card has dial spaces for twelve months' readings, besides blanks for all necessary information concerning the installation, remarks, etc. By an ingenious system of punches around the edges of the cards, it is possible to detect at a glance when even a single card is misplaced in a group of several hundred cards relating to a given locality.

The inspectors copy down only the pointer positions on the blank dials of the cards, and from these sketches the actual numerical readings are set down by the computers at the meter-department headquarters. The computers then calculate the kilowatt-hours consumed and also make out the gross bill in dollars and cents, based on the customer's rate for service. From this point the bill is handed over to the accounting department, which enters discounts, etc., and attends to rendering the account.

An experienced inspector can read about 175 meters per day, while under special circumstances one man has made a record of 430 readings in a day. For all errors above two during each half-month the reader suffers a reduction in salary of 1/16 cent per hour. While this reduction is very nominal and involves no hardship, its institution has resulted in improved care and accuracy.

During 1913 the Philadelphia meter department

FIG. 44—ELECTRIC SIGNS ON MARKET STREET

made 668,000 meter readings, among which 1400 errors were detected before the bills were sent out. In all 572,000 bills were rendered, and of this number one-half of 1 per cent were returned, although after final investigation less than half of these—that is, 0.22 per

FIG. 45—NITROGEN-FILLED TUNGSTEN STREET LAMPS ON DIAMOND STREET

cent of the total number rendered—were found to be actually in error.

All meters are mounted on approved inclosed installation boards and in the shop are wired up complete with cut-outs, etc., so that the work of installing on the customer's premises is reduced to a minimum. A regular routine is followed by which an inspector first

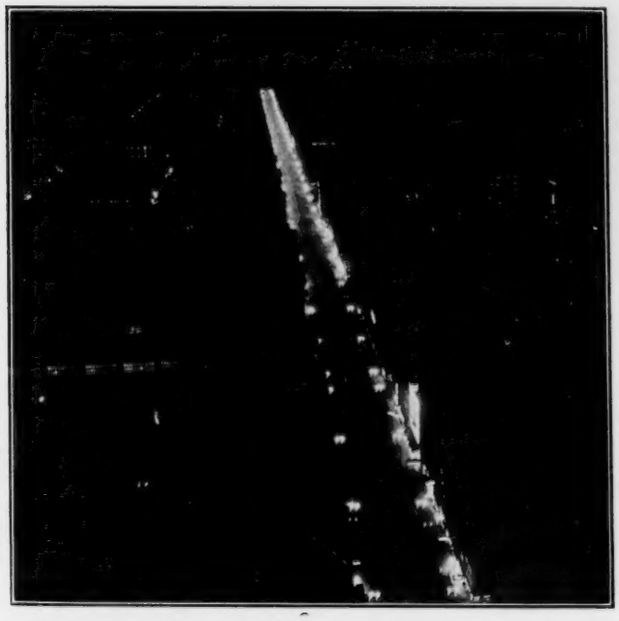


FIG. 46—ILLUMINATION OF WEST MARKET STREET VIEWED FROM CITY HALL TOWER

visits the prospective "job," estimates the material required, and hands in a corresponding requisition. The next day, with all the necessary supplies, one of the installation crews goes to the spot and quickly completes the installation.

Modern Accounting Methods

Each month the accounting department tabulates and distributes over the company's 140 operating and construction accounts about 6000 purchase invoices. To simplify this accounting work the vendor is asked to use a standard bill form, a copy of which is sent out with each order by the purchasing agent. After the approval of the purchasing department or other officials concerned has been noted on the bill as rendered, a voucher is made out and the bill itself sent to the tabulating department. Here Hollerith cards are prepared, showing the bill number, date, classification, amount, etc., duplicate green and manila copies being punched separately for verification. At the close of the month all operating expenses, construction charges and other accounts payable can be quickly obtained by running the set of cards through the electrical tabulator, accomplishing a saving of several days' time over addition by hand.

FIG. 47—ILLUMINATION OF STREET IN DOWNTOWN BUSINESS SECTION

For indexing consumers' ledgers use is made of the Rand visible index, which has replaced the file of 120,000 cards formerly required for indexing the company's 60,000 customers classified both under name and under street address. These duplicate card indexes, together with the applicant's credit file, have now been discontinued and are replaced by the visible index cards, which show directly at all times the customer's name, address, ledger folio, meter reading, routes and similar information.

When the overlapping card is raised a full history of the company's entire transactions with the customer is exposed, showing the previous address to which service was furnished to a customer of the same name, the date customer discontinued service, his indebtedness, if any, disposition of account, etc. The cards of discontinued customers are placed in transfer files, where they may be consulted along with the "live" index in the case of new service applications or for any other reason that may arise.

FIG. 48—LIBRARY FOR USE OF COMPANY EMPLOYEES

FIG. 49—EMPLOYEES' ATHLETIC FIELD

Employees' Activities and Welfare Work

The active National Electric Light Association company section at Philadelphia now numbers nearly 900 members and exhibits a degree of enthusiasm creditable in the extreme to the parent association. It holds a general section meeting once a month, in addition to which there are monthly sessions of each of the commercial, accounting, meter and engineering branches of the section. Among the section's other activities are a creditable amateur orchestra, and the publication of an excellent and valuable monthly section organ, *Current News*, the cost of which is met directly by company appropriation.

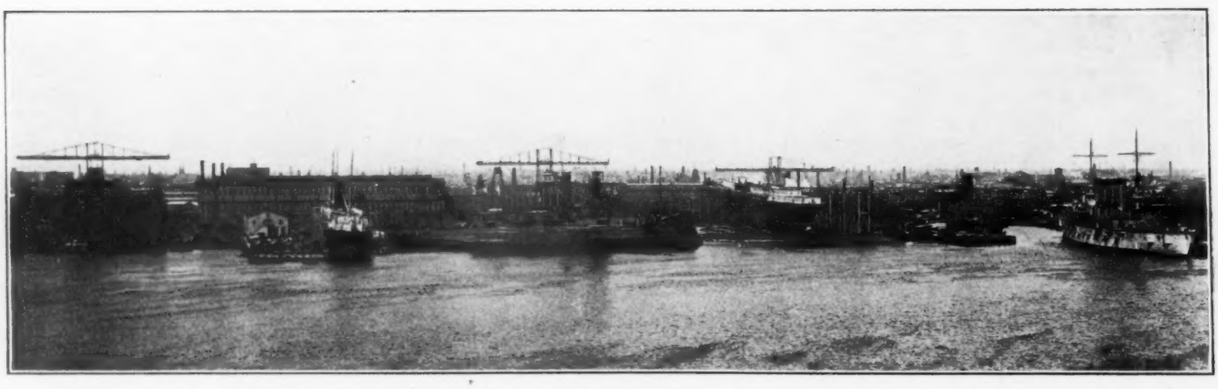
Closely affiliated with the N. E. L. A. section is the Philadelphia Electric Company Athletic Association, which has a 25-acre athletic field at the edge of the city. This field is equipped with tennis courts, baseball diamonds, golf course, grandstand and an attractively appointed field house. Restaurant facilities are also provided at popular prices. Membership fees are apportioned on a classified scale, ranging from family membership with unlimited guest privileges, at $10 a year, down to $1 a year and 50 cents a year for single membership tickets for men and women employees respectively. Boys earning less than $25 a month have the use of the association grounds free. Family membership without guest privileges costs $2 a year.

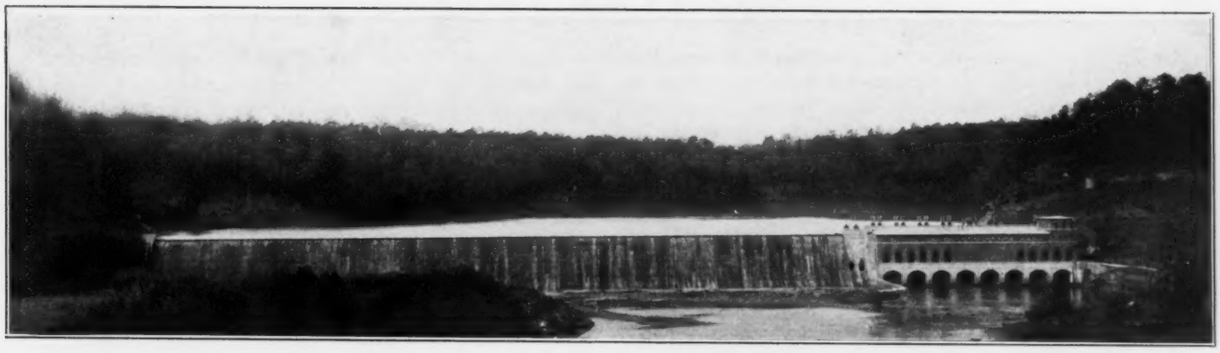
The Beneficial Association is an organization of employees fostered by the company and having as its purpose the payment of sick, accident and death benefits to employees or their beneficiaries. In addition to an entrance fee of $1, each member pays monthly dues amounting to 1 per cent of his monthly earnings. The company also contributes a sum equal to that contributed by the employees. For sick disability a member is allowed one-half of his regular pay for a period not exceeding ten weeks. In case of accident either on duty or off duty the full rate of pay is allowed. The minimum death benefit is usually $750, and this is increased to $1,000 if the member has been for five years in the employ of the company. Members who visit the office of the medical director receive free medical attention and treatment.

Employees who have reached the age of sixty-five and have been fifteen years in the company's employ may retire from active service under the company's service annuity plan, by which they receive from the company an annuity amounting to 2 per cent of their annual earnings for the last ten years multiplied by the number of years of service. For women the age of retirement is sixty years.

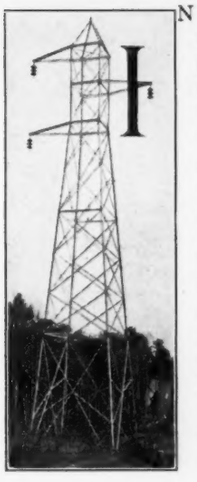
The library maintained by the Philadelphia Electric Company at its main office building is open to all employees of the company. It consists of 1275 bound volumes on engineering and commercial subjects, association proceedings, encyclopedias, reports, biographies, bulletins of company sections, of the N. E. L. A., etc. In addition to these bound volumes there are on file a number of pamphlets, clippings, lantern slides, photographs, trade catalogs and bulletins, government publications, etc. The library subscribes for thirty periodicals, which are bound at the end of each year. A card index of important articles appearing in the various periodicals is kept by the librarian, and this index is accessible to all employees.

The officers of the Philadelphia Electric Company are: President, Mr. Joseph B. McCall; vice-president, Mr. W. H. Johnson; second vice-president, Mr. W. C. L. Eglin; treasurer, Mr. H. C. Lucas; secretary, Mr. A. V. R. Coe, and assistant treasurer, Mr. H. R. Kern.





INTERCONNECTED SYSTEMS OF THE SOUTH



IN the rapid progress of hydroelectrical development high-tension transmission systems have ceased to be uncommon. The country, especially the West, abounds with them, and yet it is the South which has shown the greatest enterprise in doing the obvious thing in the obvious way by creating a system of transmission systems surpassing anything else in that line ever attempted in this or any other country, until at the present time a high-tension line approximately 1000 miles long stretches from Nashville, Tenn., to Henderson, N. C., tying together the hydroelectric systems of four states. With the completion of the Tallulah Falls station of the Georgia Railway & Power Company the water-powers on both sides of the Appalachian Mountains were virtually combined into one, for there were then actually connected the transmission systems of the Tennessee Power Company, the Chattanooga & Tennessee River Power Company, the Columbus Power Company, the Central Georgia Power Company, the Georgia Railway & Power Company, the Southern Power Company and the Carolina Power & Light Company. In other words, all the great transmission systems of the South, with the exception of the Alabama Power Company, are now interconnected, the lines of this system of systems extending over a wide territory from Nashville, Tenn., as far south as Columbus, Ga., and as far northeast as Roxboro, N. C. Moreover, the lines of the Alabama Power Company are not very far from those of the Georgia Railway & Power Company, and to connect the Alabama system to the others would require only about 50 miles of circuit.

At present these various systems are controlled by separate and distinct syndicates which some day may be welded into one by some master mind. Back of the Tennessee Power Company are the banking houses of E. W. Clark & Company, of Philadelphia, and Hodenpyl, Hardy & Company, of New York. The Bradys own the Chattanooga & Tennessee River Power Company. The Columbus Power Company is a Stone & Webster property, and the fiscal agents of the Central Georgia Power Company are A. B. Leach & Company, of New York. The sponsors of the Alabama Power Company are the Sperlings of London. The Atlanta properties are owned by the Georgia Railway & Power syndicate, while the great system of the Southern Power Company is owned by the Duke family of world-wide tobacco fame. The Carolina Power & Light Company is controlled by the Electric Bond & Share Company, of New York.

The interconnected properties are for the most part new, many of the hydroelectric stations having been placed in operation within a year or so, and few of the stations are over five years old. Numerous advantages obviously follow from the tying-in of the systems, but none of the companies interested has begun to reap the ultimate advantage that would be possible were the systems under a single control. The diversity-factor possibilities are enormous. First, there is a difference in time between Henderson, N. C., and Nashville, Tenn., of about one-half hour, the difference in standard time being one hour, so that on top of the diversity-factor of each single system, which varies considerably in different cities with the industries and customs of the people, the weather conditions, altitude, etc., is the greater time-factor of the interconnected system. Then, too, there is the diversity in stream flow of contiguous rivers and rivers on opposite sides of the mountains.

The Appalachian region is one of enormous rainfall, the largest found in the United States with the exception of a small portion of the Puget Sound district. The aggregate fall from the sources of streams to the sea is large, but unfortunately too gradual to produce powers cheap to develop or free from danger of back water. Another singular peculiarity of the Appalachian region is the absence of lakes, so that from end to end of the main chain there is practically no natural storage whatsoever.

The Fall Line

In considering the water-powers in the Southern Appalachian region it is necessary to take up the important matter of fall line, which throughout that region is well defined, as shown on the map. The streams with but few exceptions fall in gradual descents from their mountain sources to the fall line. This gradual descent includes shoals at various points in the stream where the river may fall as much as 10 ft. in from one-quarter to one-half of a mile of its course. Shoals of from 6 ft.

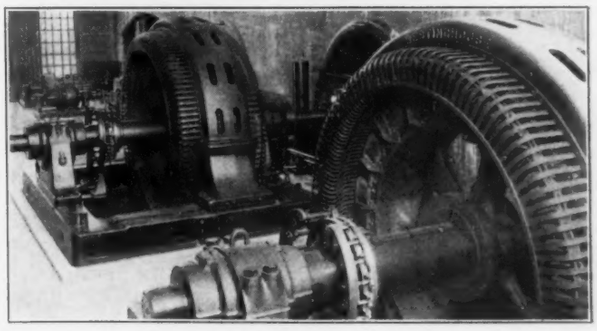


FIG. 1—GOAT ROCK STATION OF COLUMBUS POWER COMPANY

to 10 ft. may be one or two miles apart where the stream flows through a ridge, and thus a succession of shoals may occur. From this it is evident that high heads do not exist as a rule, that flumes and penstocks are little used, and that the form of development which with very few exceptions will be indicated is the building of a dam at the most favorable location on the stream which backs water over a succession of three or

FIG. 2—TALLULAH FALLS PLANT OF GEORGIA RAILWAY & POWER COMPANY

four shoals, possibly four to eight miles upstream, and thus secures a head at the point of development usually between the limits of 35 ft. and 50 ft. One advantage in the construction of practically all the water-power developments is the fact that rock, sand and timber, as well as gravel, can usually be obtained in abundant quantities not far from the power-house site.

The interconnected high-tension lines of the various systems are for the most part carried on steel towers, with suspension-type insulators, and the trend is more

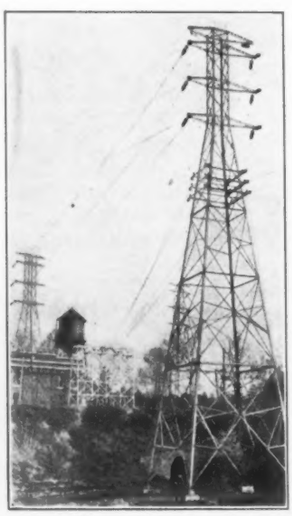


FIG. 3—LINE OF GEORGIA RAILWAY & POWER COMPANY

and more toward the outdoor type of substation and switching station. Inasmuch as the greatest operating difficulties incurred by transmission companies are those caused by lightning, all of the lines are protected by overhead ground wires and by lightning arresters of the electrolytic type. The characteristics of the various generating systems are briefly outlined in what fol-

FIG. 4—110,000-VOLT LINE OF GEORGIA RAILWAY & POWER COMPANY

lows, for convenience in connection with the accompanying map of the interconnected systems.

Tennessee Power Company

The Tennessee Power Company has two hydroelectric stations with an aggregate rating of 50,000 hp in operation on the Ocoee River near Parksville, Tenn., where

FIG. 5—HIGH-TENSION SWITCH ROOM AT TALLULAH FALLS

heads of 109 ft. and 250 ft. are available, and owns three other sites on the river where 50,000 hp can be developed. In addition, it proposes to erect an 80,000-hp plant at Rock Island and has six steam stations in opera-

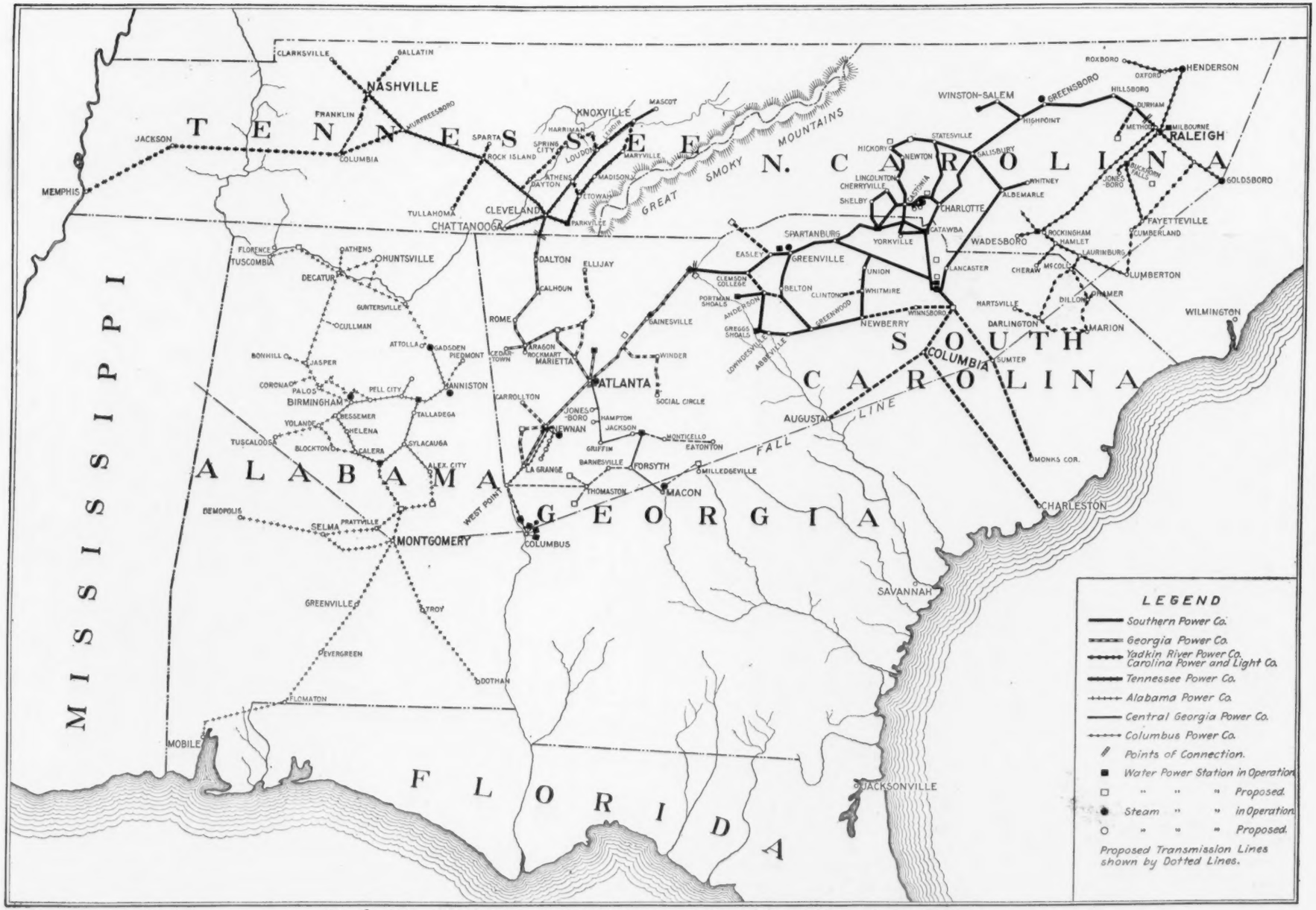


FIG. 6—MAP OF SOUTHERN INTERCONNECTED HIGH-TENSION TRANSMISSION SYSTEMS

FIG. 7—GOAT ROCK STATION OF COLUMBUS POWER COMPANY ON CHATTAHOOCHEE RIVER

tion with an aggregate rating of 25,000 hp. Substations to the number of fifteen are situated at Cleveland, Athens, Sweetwater, Ludon, Lenoir, Knoxville, Mascot, Etowah, Maryville, Chattanooga, Murfreesboro and Nashville, having an aggregate rating of 57,000 kw. The company has 453 miles of three-phase, sixty-cycle single and double circuit steel-tower lines and wooden-pole lines in operation, designed for 120,000 volts and at present operated at 66,000 volts and equipped with suspension-type insulators. In addition, there are 485 miles of high-tension line proposed, and when the system is complete the lines of the company will extend from the Tennessee-Georgia line to Mascot on the east, Clarksville on the north and Memphis on the west. The circuits of the Tennessee Power Company connect with those of the Georgia Railway & Power Company at the Tennessee-Georgia state line, the company having no transmission line outside of the State of Tennessee. The system of the Tennessee Power Company is tied in with that of the Chattanooga & Tennessee River Power Company at Chattanooga.

Rising in the mountains of northern Georgia, the Ocoee River flows through a region of heavy rainfall in a northwesterly direction to a point near Parksville, Tenn., where it joins the Hiawassee. The river falls some 710 ft. in 26 miles of its course above Parksville, where the first development was made. The second development, which has just recently been completed, is situated 8 miles above Parksville opposite the mouth of Caney Creek. This second development differs from the usual hydroelectric work of the South in that a diversion dam has been built about 12 miles above Parksville, from which water is carried in a flume 4½ miles along the mountain side overlooking the river to the penstock intake situated directly above power house No. 2 at the upper end of Lake Ocoee. This flume is large enough to provide for an ultimate installation of 30,000 brake-hp. It is a wooden structure designed for a waterway, 14 ft. 2 in. wide and 9 ft. 9 in. deep, when carrying the maximum amount of water. Across small ravines the flume is supported on timber trestles, and at five of the ravines steel trestles are provided, the largest of these having a length of 288 ft. and a maximum height of 150 ft. The generators in the second development are rated at 9375 kva, 6600 volts, three-phase, and are directly connected to 10,000-hp horizontal turbines of the inward-flow double-discharge reaction type. A feature of the development is the use of a siphon spillway because the available length of the crest of the concrete spillway dam was not sufficient to discharge 1200 second-ft. of water when acting as an ordinary overflow spillway.

Station No. 2 is equipped with two three-phase transformers, each of the same rating as the generators. These are of the oil-insulated, water-cooled type, wound on the high-tension side for 66,000/120,000 volts, sixty cycles. The transformers are delta-connected on the high-tension side and are at present operated at 66,000 volts. The energy is transmitted from Station No. 2 to Station No. 1 over a double-circuit, single-tower line built on a 1000-ft. right-of-way. The line follows the lake from Parksville to a point about one-third of a mile below Power House No. 2, where it crosses the Ocoee River in a 1300-ft. span at an elevation of about 400 ft. The country being quite mountainous, the spans vary considerably, from 350 ft. to almost five times that length. The steel transmission towers are of the double-circuit type with cross-arms spaced for 120,000 volts.

Chattanooga & Tennessee River Power Company

The Chattanooga & Tennessee River Power Company recently completed a hydroelectric development at Hale's Bar, 33 miles below Chattanooga on the Tennessee River (see *Electrical World*, Nov. 15, 1913). The generating equipment comprises ten three-phase, sixty-cycle, 6600-volt alternators, rated at 3000 kw each,

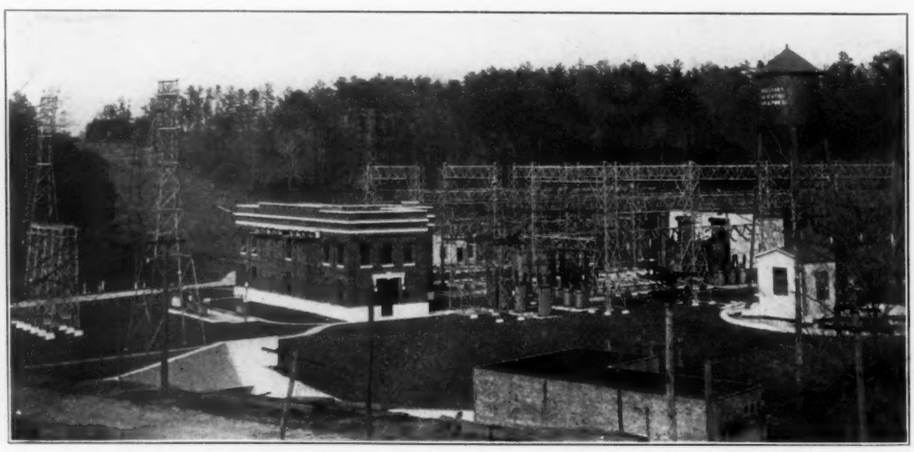


FIG. 8—OUTDOOR SUBSTATION OF GEORGIA RAILWAY & POWER COMPANY AT ATLANTA

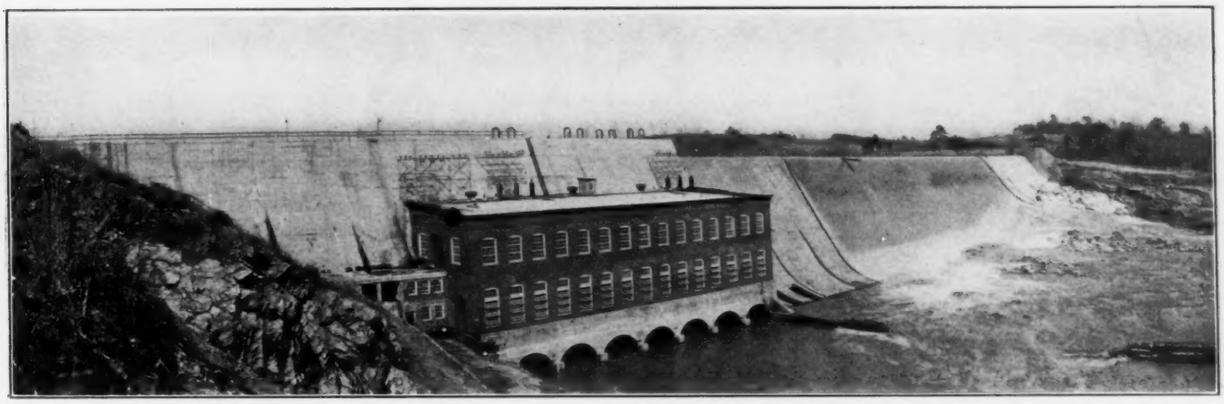


FIG. 9—STATION OF THE CENTRAL GEORGIA POWER COMPANY ON THE OCMULGEE RIVER

driven by three turbines, the two lower ones operating during periods of high head and low flow, while the upper turbine is brought into play when there is more water but less available head. The turbines run at 112 r.p.m., and each unit is capable of delivering 5250 hp under a head of 35 ft. The energy is stepped up in water-cooled, single-phase transformers rated at 3133 kw each and delivering 44,000 volts on the high-tension side. The transmission line consists of No. 000 bare-

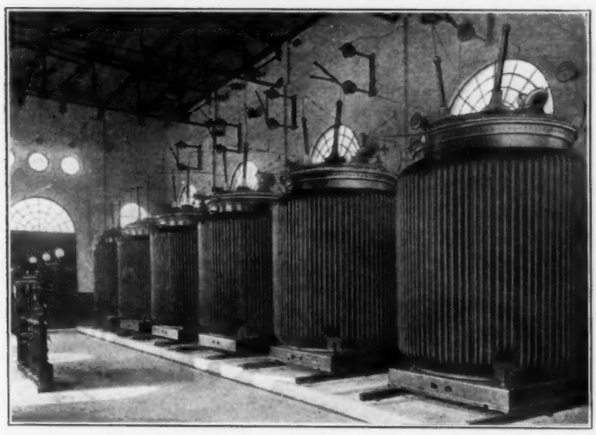


FIG. 10—ATLANTA SUBSTATION OF CENTRAL GEORGIA POWER COMPANY

copper cables on pin insulators, and the line in duplicate is carried on steel towers from Hale's Bar to Chattanooga. A contract has recently been concluded whereby 10,000 kw is taken by the Tennessee Power Company.

Columbus Power Company

The Columbus Power Company has three hydroelectric developments on the Chattahoochee River, two at Columbus having an aggregate rating of 7900 kw and one at Goat Rock, 15 miles north of Columbus, having 12,500 kw installed, making the total available 20,400 kw. The City Mills development at Columbus comprises five generators with an aggregate rating of 1000 kw, the head being 10 ft. The North Highlands development has six generators, with an aggregate rating of 6900 kw, and waterwheels operating under a head of 42 ft. The Goat Rock development, where a head of 72 ft. is available, has three generators, two of which are rated at 3750 kw and the other at 5000 kw. Three phase, sixty-cycle energy is generated at 5500 volts and 11,000 volts. Two 4000-kw transformers step up the potential to 66,000 volts for transmission. A 11,000-volt line on wooden poles with pin-type insulators connects the Columbus and Goat Rock properties, and a 60-mile steel-tower line equipped with suspension-type insulators and operating at 66,000 volts extends from Goat Rock at Newnan. There are 18 miles of wooden-pole line operating at 11,000 volts connecting Newnan and Hogansville. Four main substations are connected to the system, one at Columbus rated at 1600 kw, one at West Point rated at 1875 kw, one at La Grange rated at 1875 kw, and the fourth at Newnan rated at 4000 kw. The system operates continuously on a 40 per cent load-factor basis, and auxiliary steam generating apparatus of the capacity of 3000-kw turbo-generators is available. Provision is made for the transfer of 3000 kw between the Columbus Power Company's system and the system of the Georgia Railway & Power Company.

Georgia Railway & Power Company

The Georgia Railway & Power Company's system comprises the great hydroelectric development at Tallulah Falls recently completed (see *Electrical World*, Dec. 20 and 27, 1913), with a present equipment of 50,000 kw and an ultimate equipment of 60,000 kw, sixty-cycle, three-phase, 6600-volt generators driven by turbines designed for an average head of 600 ft.; a 10,500-kw hydroelectric station at Morgan Falls (Bull Sluice) generating 2200-volt, twenty-five-cycle energy; a hydroelectric station at Gainesville (Dunlap), where 2200-kw of two-phase, 440-volt apparatus is installed, and two steam stations in the city of Atlanta with an aggregate rating of 21,500 kw. The company has six main substations in Atlanta (Boulevard), Gainesville,

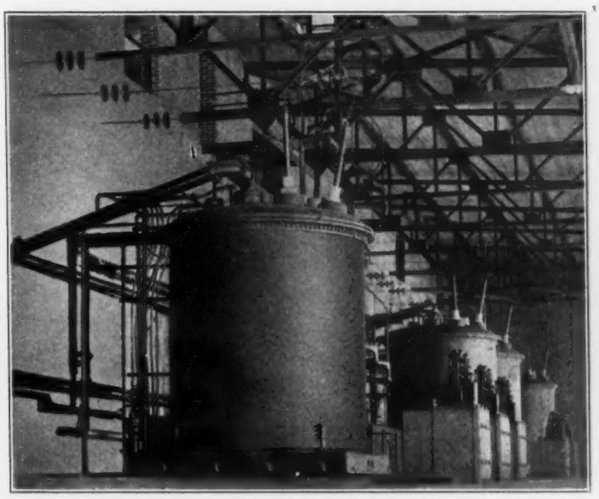


FIG. 11—TRANSFORMER ROOM, CENTRAL GEORGIA POWER COMPANY

FIG. 12—PANORAMIC VIEW OF NINETY-NINE ISLAND STATION OF SOUTHERN POWER COMPANY ON BROAD RIVER

Newnan, Lindale, Cartersville and Marietta, with a present aggregate rating of 46,500 kw and an ultimate rating of 114,000 kw. It also owns undeveloped water-powers aggregating 140,000 kw. A double-circuit steel-tower line, 87.6 miles long, transmits energy at 110,000 volts between Tallulah Falls and Atlanta; a 42.4 mile tower line with a single circuit transmits 110,000-volt energy from Atlanta to Newnan, and a similar line, 68.6 miles long, carries 110,000-volt energy from Atlanta to Lindale, making 198.6 miles of 110,000-volt steel-tower line equipped with suspension-type insulators. The main line from Atlanta to Tallulah Falls is equipped with No. 0000 copper conductor, and the substations are for the most part of the outdoor type, that at Atlanta being the largest of that type at present in existence. A 66,000-volt wooden-pole transmission line, 62 miles long, extends from Lindale to the Tennessee state line, where connection is made with the Tennessee Power Company's system. There are 28.8 miles of 22,000-volt line connecting the Bull Sluice station with Atlanta and connecting Atlanta with Smyrna. There are also 18.95 miles of 11,000-volt lines in the city of Atlanta. The total mileage of transmission and distribution lines operated by the company is 519.45 miles, 211.1 miles of which is made up of 22,000-volt and 11,000-volt distributing lines. The company receives energy over a 66,000-volt line on steel towers at South Atlanta from the Central Georgia Power Company, and the Tallulah Falls plant is connected with the system of the Southern Power Company at Tallulah Falls.

The Georgia Railway & Power Company operates the electric railways in Atlanta, a direct-current system, an alternating-current system and a steam-heating system. Nearly all of the load is carried by the water-power stations, the steam engines being run only during the heating system and in case of emergency. At each of the steam plants in Atlanta sufficient boilers are kept under steam to pick up about 2500 kw on short notice. In addition, there is a 3000-hp gas engine in the Davis Street station in Atlanta directly connected to a 2000-kw, twenty-five-cycle, three-phase, 6600-volt alternator. This engine can be started and put in service in less than a minute. It is run on illuminating gas supplied by a 16-in. main direct from the gas holder, and besides being available for emergency service, it is also used during periods of low water to tide the system over peak loads.

FIG. 13—ROCKY CREEK STATION OF SOUTHERN POWER COMPANY ON CATAWBA RIVER

Central Georgia Power Company

The Central Georgia Power Company operates a 12,000-kw hydroelectric station at Lloyd's Shoals on the Ocmulgee River near Jackson, where a head of 100 ft. is available. The equipment comprises four 2300-volt, sixty-cycle, three-phase, 3000-kw generators, and the energy is stepped up to 66,000 volts for transmission. The most important transmission line is that extending

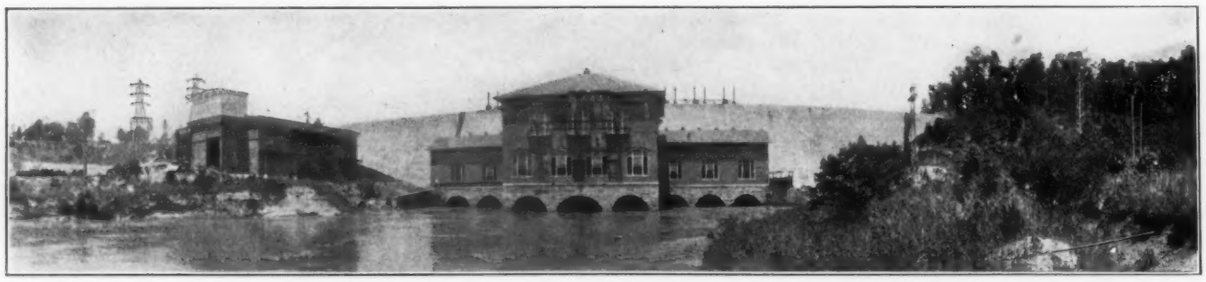


FIG. 14—GREAT FALLS STATION OF SOUTHERN POWER COMPANY ON CATAWBA RIVER

from Griffin to Atlanta, a distance of about 34 miles. The steel towers carry two stranded aluminum circuits, one on each side, over a 150-ft. right-of-way to Atlanta. The company has 226 miles of line on a single-circuit basis, 202 miles of steel towers on a single-circuit basis,

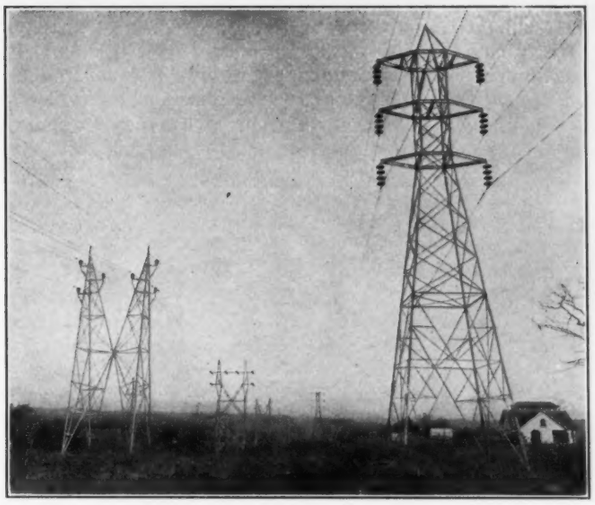


FIG. 15—TRANSMISSION LINES OF SOUTHERN POWER COMPANY

and 24 miles of wooden-pole line. One hundred and fifty-six miles of single circuit line are equipped with pin-type insulators, and 70 miles of single-circuit line have insulators of the suspension type. Substations are situated at Atlanta, equipped for 9000 kw; at Hampton, rated at 1100 kw; Griffin, rated at 2250 kw; Jackson, where 900 kw is installed; Monticello, having 900 kw in equipment; Forsyth, rated at 1200 kw; Barnesville,

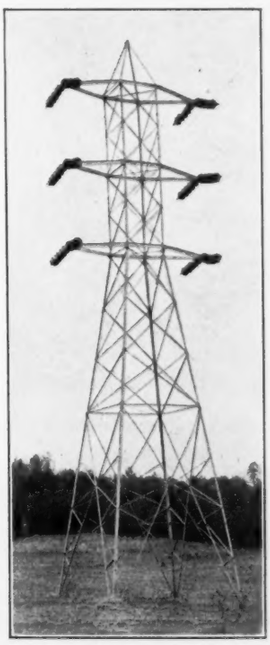


FIG. 16—YADKIN RIVER COMPANY'S TRANSMISSION LINE

also rated at 1200 kw, and Macon, where 9000 kw is installed. Provision is made for the transfer of 9000 kw between the Central Georgia Power Company's system and that of the Georgia Railway & Power Company at Atlanta. Steam auxiliary equipment up to 5500 hp can be pressed into service whenever required.

Southern Power Company

The Southern Power Company is connected to the

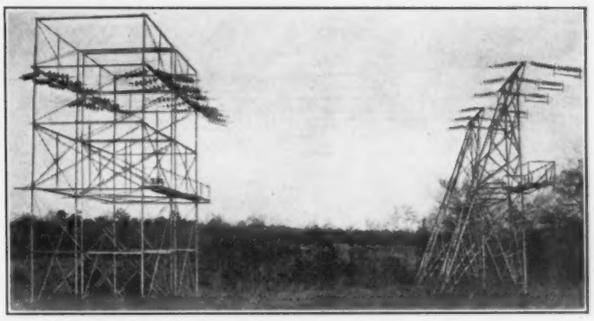


FIG. 17—JUNCTION OF SOUTHERN POWER COMPANY'S AND CAROLINA POWER & LIGHT COMPANY'S LINES

Carolina Power & Light Company at a point between Durham and Raleigh, N. C., as indicated on the map,

DATA ON SOUTHERN POWER COMPANY'S STATIONS

Location	Maximum Rating	Head, Ft.
Great Falls, S. C.	24,000 kw	72
Rocky Creek, S. C.	24,000 kw	63
Ninety-nine Islands, S. C.	18,000 kw	72
Catawba, S. C.	6,600 kw	25
Lookout Shoals, N. C. (under construction)	24,000 kw	76
Greenville, S. C. (steam)	8,000 kva	..
Greensboro, N. C. (steam)	8,000 kva	..
Mount Holly, N. C. (steam)	8,000 kva	..

and with the Georgia Railway & Power Company at Tallulah Falls. The location and maximum ratings of

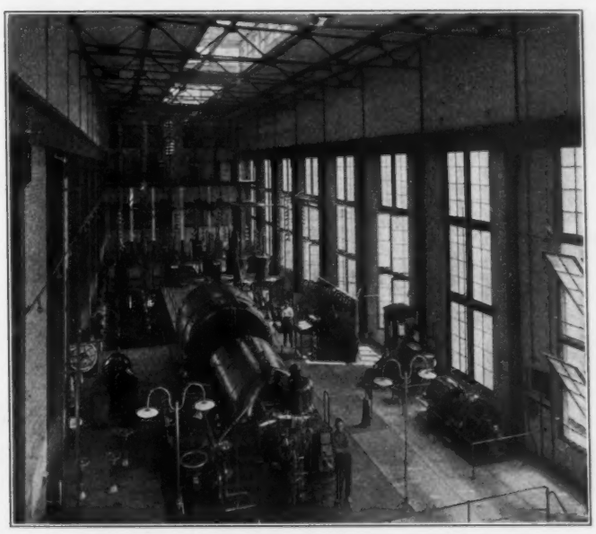


FIG. 18—GREENSBORO STATION OF SOUTHERN COMPANY

the company's various stations are given in the accompanying table.

Electricity is generated at 2200, 6600 and 11,000 volts, three-phase, sixty-cycle, there being one 8000-kva, 2300-

volt and two 8000-kva, 11,000-volt steam-driven generators, twenty-two 3000-kva, 3000-volt generators, three 7800-kva, 6600-volt generators, four 900-kva and four 750-kva, 11,000-volt generators. The last thirty-three units are of the waterwheel type. There are also connected to the system sixty-five high-voltage transformers having an aggregate rating of 169,400 kva.

The lines of the company cover a territory of 300

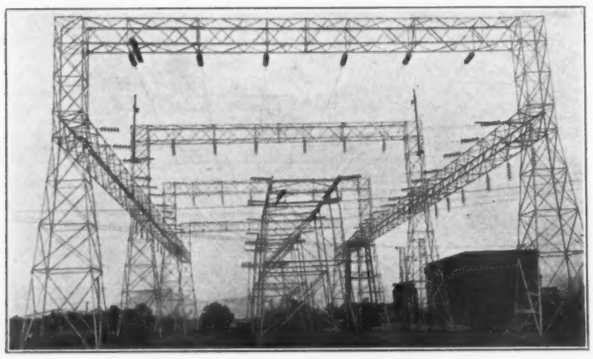


FIG. 19—OUTDOOR STATION OF ALABAMA POWER COMPANY AT ANNISTON

miles in a northeasterly and southwesterly direction and 100 miles in a northwesterly and southeasterly direction. The first transmission system of the company was designed for 11,000 volts. With the expansion of the company and its activities, a 44,000-volt transmission system was built, and all of the recent transmission lines erected by the company have been designed for 100,000 volts. All lines are looped in together, and the 11,000-volt, 44,000-volt and 100,000-volt systems are tied together with tie-in transformers. Aluminum and copper are both used for conductors, the size ranging from No. 4 solid copper to No. 000 stranded. By far the greatest amount of the lines are of No. 00 copper stranded and No. 00 equivalent aluminum stranded. This is run on both steel towers and wooden poles with pin-type and suspension-type in-

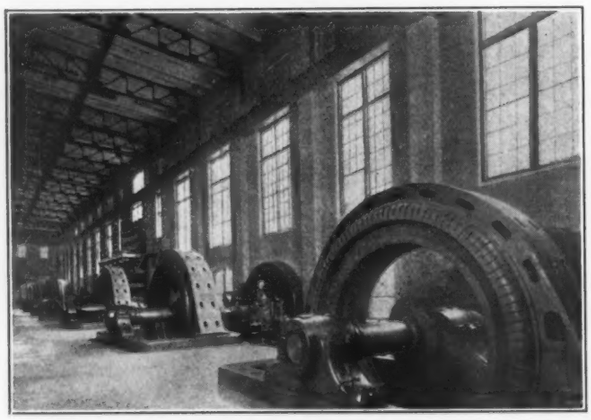


FIG. 20—BLEWETT FALLS STATION OF YADKIN RIVER POWER COMPANY

sulators, depending upon the voltage. There are 103 substations connected to the system, containing 352 transformers with an aggregate rating of 241,162 kva.

The circuits of the Southern Power Company are connected on the north with those of the Carolina Power & Light Company with two 00, 100,000-volt lines. The amount of power that can be transferred is limited only by the carrying capacity of these lines, as no transformers are required in order to effect this connection. On the south the Southern Power Company's system is connected with that of the Georgia Railway & Power Company at Tallulah Falls, with two 00, 100,000-volt lines, and the power which can be transferred between the two companies at this point is limited only by the carrying capacity of the lines.

It should be pointed out that the rating of the hydroelectric stations of the Southern Power Company is based upon the continuous rating for the continuous amount of twelve-hour power which the station can generate for eight months in the year. The company maintains three 8000-kva turbo-generator steam plants for

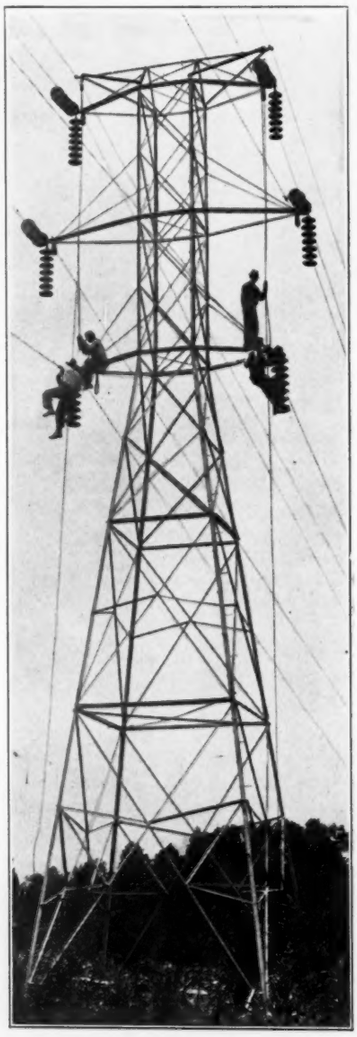


FIG. 21—TRANSMISSION LINE OF ALABAMA POWER COMPANY

emergency and supplementary service. The fires under the boilers are banked, and all three stations can be got under way to feed energy to the lines within fifteen minutes.

On the map are indicated the Portman Shoals generating station, consisting of four 600-kw generators; the Gregg Shoals generating station, equipped with four 500-kw generators, and the Idyls plant, near Winston-Salem, equipped with five 300-kw generators as part of the Southern Power Company's system. These three stations are the property of the Southern Public Utilities Company, as is also the Saluda plant at Greenville, S. C., which contains five generators with a total rating

of 2600 kva. The Southern Public Utilities Company has taken over these public utilities, which were formerly owned and operated by the Southern Power Company. These plants are not, however, included in the summary given in the foregoing.

The Carolina Power & Light Company

The Carolina Power & Light Company operates 187.6 miles of high-tension transmission lines, connecting two hydroelectric and three steam stations with the distribution systems in Raleigh, Goldsboro, Henderson, Oxford, Sanford, Jonesboro, Fayetteville, Clayton, Smithfield, Selma, Franklinton, Pine Level and Cumberland. The larger of the hydroelectric plants is at Buckhorn Falls, on the Cape Fear River, and is rated at 3300 hp. The other hydroelectric plant is rated at 530 hp and is situated on the Neuse River near Raleigh. The steam stations comprise a 5000-hp plant at Raleigh, a 950-hp plant at Goldsboro and a 300-hp plant at Henderson. Nine substations are connected to the system, having an aggregate rating of approximately 23,000 hp.

The Carolina Power & Light Company also controls the Yadkin River Power Company, which owns and operates the hydroelectric development on the Yadkin River at Blewett Falls near Rockingham, N. C. This development has an initial rating of 32,000 hp. The company has in operation 185 miles of 100,000-volt transmission lines situated on private right-of-way and 49 miles of distribution lines. Five substations, with an aggregate rating of 4100 hp, are connected to the system, which supplies a number of towns in the Carolinas. The company sells to the Southern Power Company under contract 8000 hp.

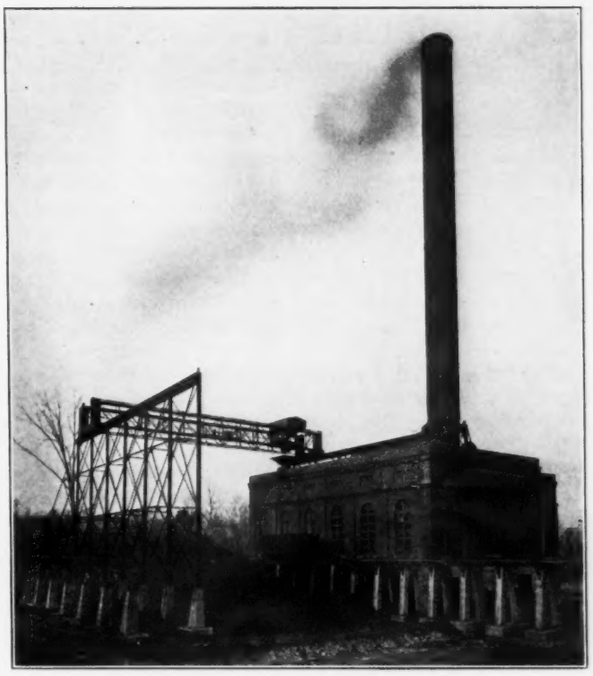


FIG. 22—GADSDEN STATION OF ALABAMA POWER COMPANY

Alabama Power Company

The properties owned by the Alabama Power Company include several sites on the Coosa River, one site on the Tallapoosa River, a site on Little River, and sites at Muscle Shoals on the Tennessee River. On these sites approximately 500,000 hp can be developed. The hydroelectric stations of the company at present in operation are located at Lock 12 on the Coosa River, where a head of 68 ft. is available, and at Jackson Shoals, on Choccolocca Creek, where a head of 22 ft. is available. In the Coosa River station, work on which is still under way, there are now four units installed, each rated at 17,500 hp. The Jackson Shoals plant is rated at 2500 hp. Sixty-cycle, three-phase energy is generated at 6600 volts in the Coosa River plant and 2300 volts in the Jackson Shoals plant. The company has at present in operation 180 miles of steel-tower transmission lines equipped with suspension-type insulators and 00 stranded copper cable for transmitting energy at 110,000 volts to four substations over private rights-of-way. The substations are situated at Gadsden, Anniston, Jackson Shoals and Magella near Birmingham. Substations operated at 22,000 volts are in operation at Talladega, Leeds, Lovick, Alexander City, Gadsden and Attalla. The high-tension substations are of the outdoor type. It is the purpose of the company to standardize these as to size and type on 3000, 6000 and 10,000-kva ratings. At present 45,300 kva is installed in the four substations. The company has 25,000 kw of available steam auxiliary apparatus, comprising a 12,500-kw steam turbine station at Gadsden, containing two 6250-kva units, and a 15,000-kw steam turbine and reciprocating engine plant. With the available steam auxiliary of 25,000 kw operating as required and furnishing approximately 7.55 per cent of the total kilowatt-hour output, 62,400 kw of primary power at 50 per cent load-factor can be delivered as soon as another hydroelectric unit is installed. The Anniston substation is a switching station for two 110,000-volt lines which pass through it. The Jackson Shoals substation is also a switching station for three 110,000-volt circuits from the north, south and west. The Magella substation will have an ultimate rating of 67,000 kw.

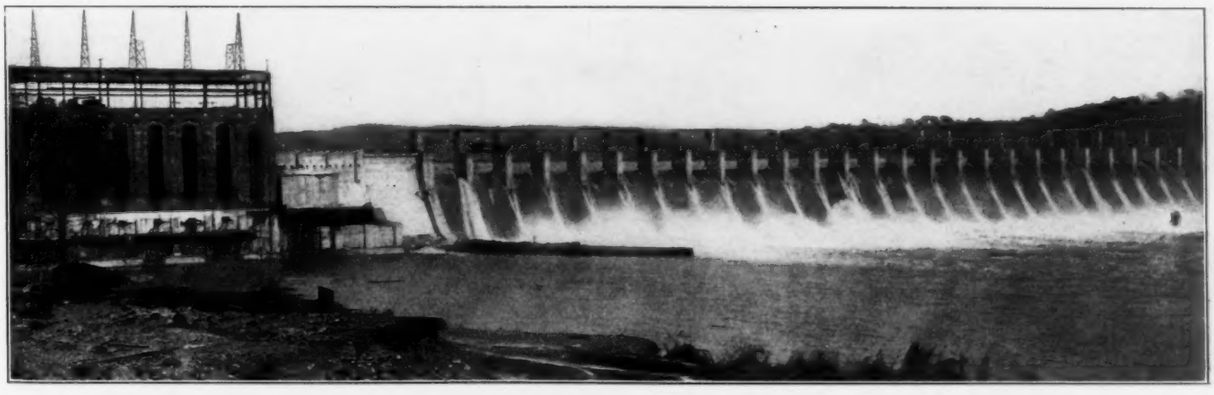


FIG. 23—STATION OF ALABAMA POWER COMPANY AT LOCK 12 ON THE COOSA RIVER

POLE AND TOWER TRANSMISSION LINES

By R. D. Coombs

THE rapid growth of the electric-lighting industry within the last decade has caused an enormous increase in both the number and the length of transmission and distribution lines. From a comparatively unimportant detail of little interest even to the owner, the distribution lines have developed into quite pretentious systems, whose relation to other industries and to the public must be taken into consideration.

The occasional transmission systems of 11,000 volts carried upon wooden-pole lines with spans of 120 ft. have developed into 140,000-volt lines on steel towers, with spans of from 500 ft. to 800 ft., while the light wooden poles supporting a few arc circuits have become in some cases heavy trunk lines.

As is to be expected in a growing industry, no standard has been universally accepted. Moreover, it is impracticable for any one specification or standard of construction to be universally applicable unless such a standard has some elasticity and is interpreted and enforced with intelligence.

In any attempt at standardization it is very necessary to weigh carefully the result, both in cost and in operation, of the adoption of any general mechanical requirement. An assumption appearing innocent and harmless may become very serious if applied to all future construction, through the too common practice of copying or compiling specifications.

The number, size and voltage of the wires and the type of insulation to be used belong to the field of electrical engineering; the subsequent determination of the best method of carrying the conductors across country is purely a question of civil engineering. In the above division of work the terms "electrical" and "civil" are used in their narrow sense, but the division is important as denoting the proper apportioning or departmentizing of the subsequent work. In this age of specialists there is no more reason why the electrician should determine structural details than there is for the structural engineer to decide upon the proper type of insulator. If the layman or worker in another branch of the engineering profession has hesitated to assume authority in electrical matters, the same cannot be said of the average electrical expert in the field of pure construction. This is, no doubt, due to the fact that his brothers in the co-ordinate branch of the pro-

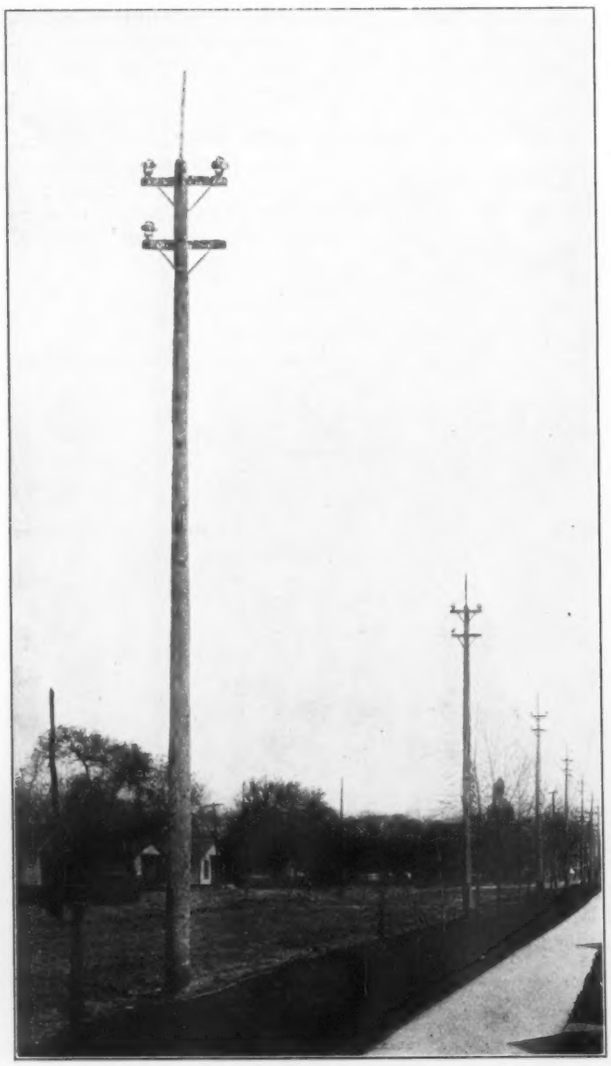


FIG. 1—ONE-CIRCUIT WOODEN POLES, 33,000 VOLTS

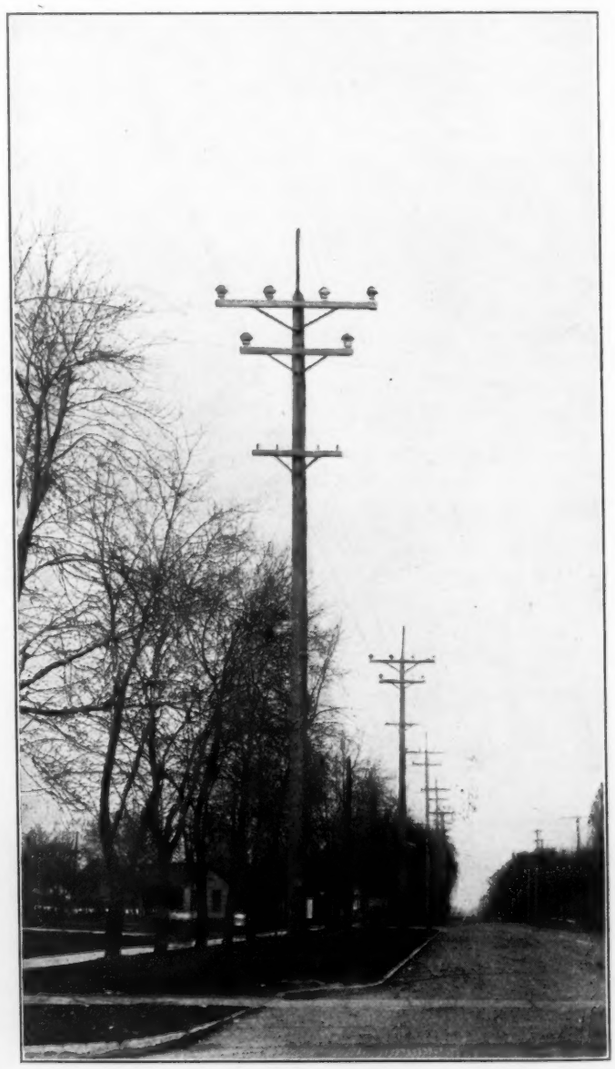


FIG. 2—TWO-CIRCUIT WOODEN POLES, 33,000 VOLTS

fession have done little or nothing to solve the problems properly assignable to the construction engineer.

That this is no imaginary charge is proved by the history of transmission-line construction. Until recent years the rule-of-thumb practices of telephone lines, worthy results of the test of time as many of them are, were followed blindly by those charged with the transmission of electrical energy in large quantities. The natural result is found in the existence of improperly constructed lines and the prevalence of entirely erroneous ideas as to the facts and principles involved. This condition should no longer be permitted to obtain; the electric-lighting industry should advance with some approach to uniformity in all associated lines. If the electrical questions relating to pole and tower lines are being solved with great rapidity, there is incumbent upon some branch of the engineering profession a moral duty to promote proper construction.

It is not the purpose of the writer to deal with purely electrical questions, such as the selection of the size and voltage of the wires as related to the electrical characteristics of the line, or with such very specialized matters as the design of insulators, but with the known laws of mechanics, which have been little changed for ages, and the problem is rather to develop a clear perception of their application to the case in mind.

Type of Line Construction

The type of construction for transmission companies on private rights-of-way may be said to depend on the cost of construction versus the cost of interruptions to service and maintenance. This is also true, though to a less extent, of certain classes of electric lines for railroads.

Where the lines of the transmission company are on public property or cross other lines, or when high-tension lines are used by railroads for purposes of electric traction, the cost of failures of construction will be found to exceed the additional cost of good construction.

A decision as to the exact type of line, character of supports and total carrying capacity which will provide the absolute ultimate economy as well as excellence of

FIG. 3—OVERLOADED WOODEN POLES

FIG. 4—TWO-CIRCUIT STEEL TOWERS, 110,000 VOLTS

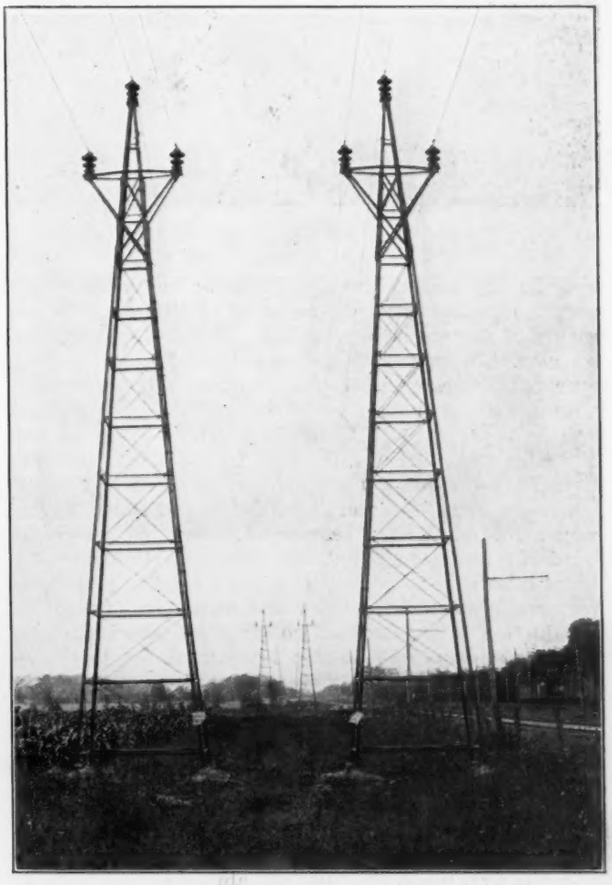


FIG. 5—TWO ONE-CIRCUIT STEEL TOWERS, 60,000 VOLTS

service is perhaps impossible. The best the designer can do is to use good judgment to care for future developments, as well as engineering skill on the immediate construction. The number of years that any line will need to remain in its original location cannot be absolutely foretold. If the line remains in place for a long period of years, will it have any considerable scrap value at the end of that period? If removed, or considerably altered, in a shorter period, the value remaining is scarcely less difficult to determine. Apart from the economic needs of the owner ten or twenty years hence, what may be the effect upon the existence of the line of federal or municipal regulation at some earlier date?

In addition to these considerations, there must also be taken into account the probable future carrying capacity and voltage, the life of the materials, and finally the relative ultimate economy of one or another type of construction as judged by the above conditions.

Carrying Capacity of Supports

Experience, at least with lower voltages, has shown that the desired carrying capacity of the supports to carry additional wires has usually been underestimated. The extremely heavy distribution lines often

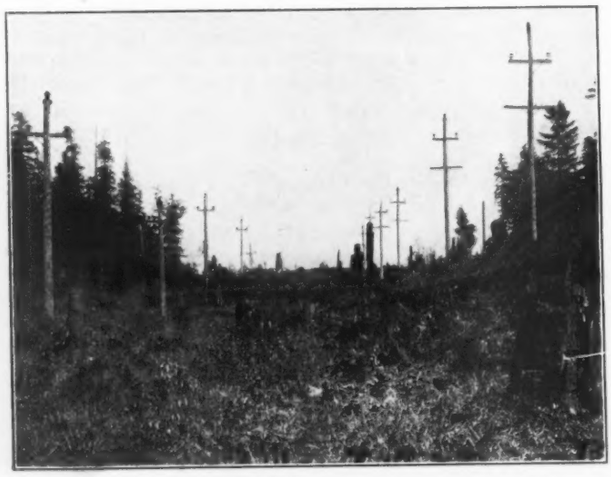


FIG. 6—TWO ONE-CIRCUIT LINES, 55,000 VOLTS

seen on city streets are not, however, an example of a proper ultimate carrying capacity of the supports but rather of an unwise overloading. Exact maximum limits cannot be set, but the occasional failure of such overloaded lines causes an expenditure which should be a weighty argument for the alternative of more and lighter lines. It is true that two lighter lines will cost more than one heavy line in so far as the actual construction cost is concerned. However, the cost of maintenance and the greater liability of extensive or prolonged interruption to service, if difficult to foretell in terms of money, are not less costly on that account. Many otherwise competent engineers seem to ignore the very real cost in time, money and reputation "saved" by a reduction in the original construction account.

The ordinary wooden-pole lines used for local distribution are subject to more alteration than transmission lines and are affected by conditions not generally applicable to transmission lines, and they are thereby less open to error. In transmission-line construction, on the other hand, the usual decision is whether to provide for one or two, two or four, four or more circuits upon a single line of supports, and in the higher voltages whether to carry one or two circuits.

In the first place, the financial ability or disability of the owner may settle the question without reference to any further considerations whatever. The best may be the cheapest, but it may also be the impossible. Under such circumstances the engineer can only build as well as is practicable with the funds available. Such lines are usually in less populous territory, where the penalties of accident are less severe than in the case of higher grade construction. The natural and entirely proper practice in such a case will be lower supports, longer spans, little future surplus carrying capacity, and lighter structures. It may be noted, however, that proper side clearances, spacing, insulation and guying add but little to the cost compared to the gain in the efficiency of the transmission line.

In what may be called the better grades of construction the number of circuits upon a single support depends very largely upon the location of the line and its present or future voltage. There is quite an important difference between lines upon private rights-of-way and those upon highways or foreign lands. It is not unreasonable to assume that the operating company may utilize any combination of heavily loaded or duplicated lines it chooses upon its own property, though that property will eventually have to be fenced and patrolled. On the other hand, the occupation of highways, etc., by overloaded, or perhaps by any, lines may become subject to criticism. Again, the holding of separated parallel or looped lines has real advantages from the commercial and service standpoint.

Dividing the total number of wires between two or more pole lines cannot be justified as a measure of reducing the cost. Such duplicate lines will always cost more than one heavy line, but the subdivision may be justified on other grounds. In case a different route is given to one line, the maximum security from simultaneous interruption to service is obtained and additional business may be secured, but the cost will be more than that of two lines on one right-of-way and nearly double that of one line of the total current-carrying capacity.

The number of circuits to be carried by a single support depends upon the current-carrying capacity and the continuity of service desired, although to some extent upon the length of span and the character of the supports. Thus the same weight of conductor, divided between two circuits, affords considerable protection against shutdown with little added cost except for higher poles, larger or more numerous arms, more insulators, etc. The single circuit can, however, be installed with greater spacing and may be used more economically in long spans.

A Frog-Leg Radio Recorder

The nervous and muscular system of the frog has been famous as a sensitive detector of electrical impulses ever since the day of Galvani and his classical observation which led to the discovery of the principle of the electric battery. Very recently, however, C. W. Waggoner, of Morgantown, W. Va., has made some experiments using the same pioneer form of physiological detector for recording the wireless impulses received from the Arlington (Va.) radiotelegraph station. Before the recent meeting of the American Physical Society he exhibited graphs of several inches amplitude recording the one-second impulses of the distant station and showing clearly the gaps marking the ends of one-minute and hourly periods. If anything, said Mr. Waggoner, the nervous system of a freshly killed frog is too sensitive for the best results, and he reported that his own best observations were made with subjects about eighteen hours after preparation.

Adjustable-Speed Polyphase Induction Motor

An eighteen-speed, double-rotor, three-phase motor designed for regulation above synchronous speed. By A. Hoeffleur and M. P. Misslin

ONE of the chief disadvantages of polyphase induction motors consists in the difficulties encountered in obtaining speed regulation without energy loss. To overcome these difficulties a number of methods have already been proposed and practically employed with success, such as speed regulation by means of two induction motors or one induction motor

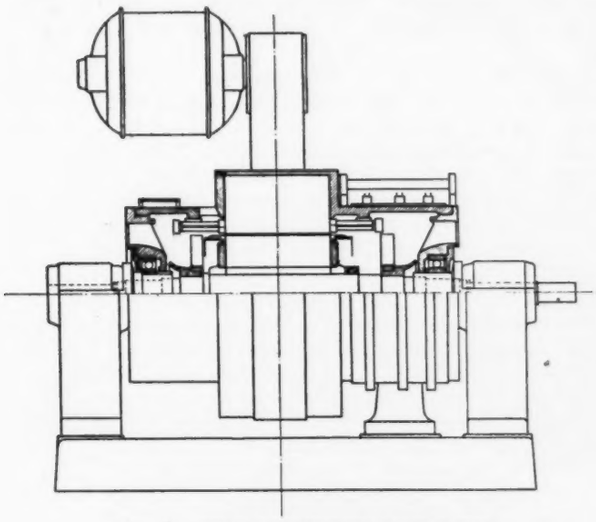


FIG. 1—BELT-CONNECTED MOTOR SET

and a commutator motor connected in cascade; changing the number of poles of the induction motors, and the use of three-phase commutator motors. All of these methods of varying the speed of polyphase motors are well known.

According to a somewhat less known and little employed method, use is made of two induction motors, of which one—that is, an "auxiliary" motor—drives the inductor of a "main" motor, with variable speed in the same or reverse direction of rotation as its rotor. With this arrangement it is possible to regulate an induction motor also above synchronous speed, whereas all other methods, with the exception of that employing a commutator, allow only a regulation below synchronous speed.

The advantage of the method mentioned above, enabling an asynchronous motor to be run above its synchronous speed, makes this speed-regulation system specially suitable for the drive of all machines demanding very high speeds for their economical operation, such as ventilators, blowers, turbine pumps, etc.

In the new system as actually carried out by the Maschinenfabrik Oerlikon, Switzerland, use is made of machines with pole-changing arrangement for the "main" as well as for the "auxiliary" motor.

Assuming a main motor permitting n and an auxiliary motor permitting m variations in the number of poles, the new combination will permit the establishment of $2nm$ speed steps. The maximum speed of a standard two-pole induction motor at a frequency of fifty cycles is 3000 r.p.m. With the new "Oerlikon double-rotor" motor it is possible to obtain at this frequency 3750 and more revolutions per minute.

The details of operation of the new method are as follows:

The rotor of a standard four-pole induction motor connected to a fifty-cycle supply system will attain at no-load a speed of 1500 r.p.m. If the stator of this motor, which hereafter may be styled the "main" motor, is made to rotate by means of a suitable device, such as a belt drive or tooth gearing with a ratio of one to four—from an induction motor running at 1000 r.p.m. in such a way that the stator rotates in the same direction as the rotor, the speed of the rotating field of the main motor will be increased by 250 r.p.m.; that is, the speed of the rotating field will be 1750 r.p.m. The rotor of the main motor at no-load will assume synchronous speed with the rotating field; that is, its speed will also be 1750 r.p.m. Both the main and the auxiliary machines operate in this case as motors. The output available at the main motor shaft equals the total watt consumption of both motors less the total of their losses. The auxiliary motor participates in the total output P with an amount equal to $\frac{P \times 250}{1500}$ while the share supplied by the main motor would be

$$P - \left(\frac{P \times 250}{1500}\right)$$

When the auxiliary motor is disconnected from the supply and the stator of the main motor kept stationary by means of a brake, the rotor of the latter motor again assumes a speed of 1500 r.p.m. When the direction of rotation of the auxiliary motor is reversed, so that the stator of the main motor, after releasing the brake and reconnecting the auxiliary motor, rotates

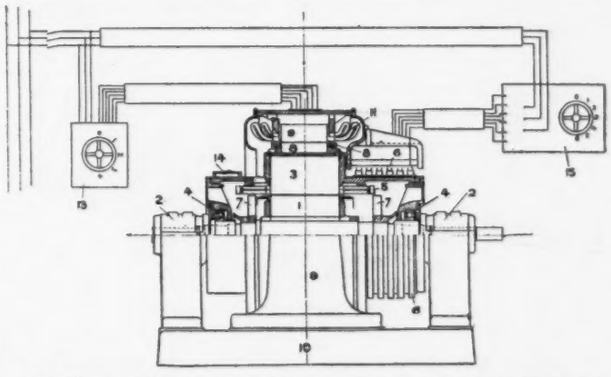


FIG 2—DIRECTLY CONNECTED THREE-PHASE MOTOR SET

again with a speed of 250 r.p.m., but in the opposite direction to that of its rotor, the speed of the rotating field, and therefore also that of the rotor of the main motor, will be decreased from 1500 to 1250 r.p.m. In this case the main motor runs as a motor and the auxiliary motor as a generator.

Fig. 1 represents schematically a motor set of the kind described. The "stator" (inductor) of the main

motor in this instance is driven by belting from the auxiliary motor. When both the main and the auxiliary motors of such a set are built as motors with a pole-changing arrangement, it is possible to obtain a regulation of speed in the ratio of 1 to 4 with twenty-six different steep steps.

By far the simplest arrangement is obtained by directly connecting together the main and the auxiliary motor, as has been effected by the Maschinenfabrik Oerlikon for the three-phase motor set recently built by this firm and represented by Fig. 2.

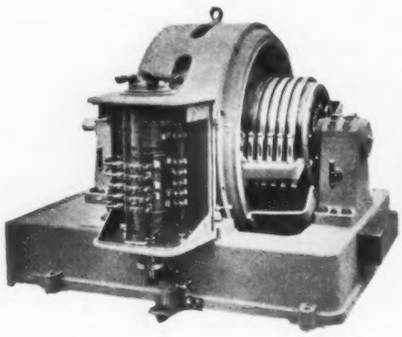


FIG. 3—MOTOR WITH POLE-CHANGER ATTACHED

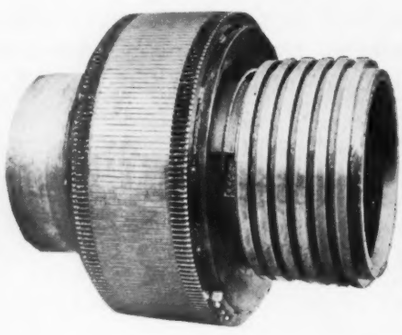


FIG. 4—ROTOR CARRYING INDUCTOR WINDINGS

FIG. 6—STATOR OF AUXILIARY MOTOR

OPERATING SPECIFICATIONS OF 500-VOLT, FIFTY-CYCLE MOTOR

Speed Steps	Synchronous Speed, R.p.m.	Output, Hp
1	3500	300
2	3375	285
3	3250	280
4	3187	270
5	3000	255
6	2813	240
7	2750	230
8	2625	220
9	2500	210
10	2000	170
11	1875	160
12	1750	150
13	1687	145
14	1500	125
15	1313	110
16	125	100
17	1125	90
18	1000	80

In the following a few constructional dates, test results and illustrations of this motor set will be given.

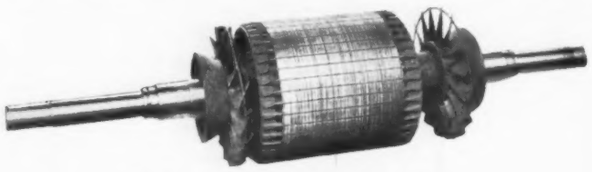


FIG. 5—SQUIRREL-CAGE ROTOR

The operating specifications of this motor, designed for 500 volts and fifty cycles, are given in the accompanying table. This motor will be employed for driving an Oerlikon air-blower, designed for supplying 3 cu. m of air per second, at 3500 r.p.m., at a pressure of 5 m water column, directly coupled with the motor. In order to obtain eighteen speed steps, the main motor with a squirrel-cage rotor has been designed as a two-speed motor, with arrangement for changing from two to four poles. Its synchronous speeds are therefore 1500 and 3000 r.p.m.

The auxiliary motor is a four-speed machine, with two windings and an arrangement for changing from thirty-two to sixteen poles and from twenty-four to twelve poles. The corresponding four synchronous speeds of this motor are accordingly 187, 250, 375 and 500 r.p.m. The rotor of the auxiliary motor is also of the squirrel-cage type, its windings being arranged around the periphery of the rotating inductor (stator) of the main motor.

The combination of the speed steps of the main and the auxiliary motor at the four-pole connection of the former gives the following speeds: 1500 ± 187 r.p.m; 1500 ± 250 r.p.m.; 1500 ± 375 r.p.m., and 1500 ± 500 r.p.m.; that is, a total of eight different speeds.

When running the main motor as a two-pole machine, the speeds obtained will be: 3000 ± 187 r.p.m.; 3000 ± 250 r.p.m.; 3000 ± 375 r.p.m, and 3000 ± 500 r.p.m.; that is, again eight different speeds.

If the auxiliary motor is disconnected and the inductor of the main motor held fast, two additional speeds of 1500 and 3000 r.p.m. are obtained, bringing the total number of speed steps obtainable to eighteen.

FIG. 7—DOUBLE BEARINGS OF MAIN MOTOR

As will be seen from Fig. 2, the squirrel-cage rotor 1 of the main motor is carried in the two ring-lubricated

bearings 2, which are designed for a speed of 3500 r.p.m. The inductor 3 of the main motor is carried by ball bearings 4, resting on the inwardly lengthened main bearings. The ball bearings have been designed for a maximum speed of 500 r.p.m. Six slip-rings 6 are provided for leading the current to the inductor windings 5 and to the device for changing the main motor from two to four poles. The two ventilators 7, fixed on the main shaft, insure efficient ventilation of the main motor. The squirrel-cage rotor 8 of the auxiliary motor is fitted directly on the outer periphery of the inductor 3 of the main motor, whereas the stator 9 of the former is firmly bolted down to the bedplate 10 of the set. The windings 11, equally arranged for pole changing, are led to terminals from which connections 12 are run to the pole-changing switch 13 of the auxiliary motor, fitted close to the stator 9. The pole-changing switch 13 of the auxiliary motor is fitted with a commutating device, permitting the reversing of the direction of rotation of this motor. The commutating device is interlocked with the drum of the pole-changing switch in such a way that the direction of rotation can be reversed only when the primary circuit is open. The starting of the set is effected by means of an auto-transformer 15. This latter is connected to the pole changer for the inductor winding 5 of the main motor.

The brake 14, serving for holding the inductor 3 of the main motor at the speeds of 1500 and 3000 r.p.m., is operated by the pole changer 13 and automatically released at all other speeds.

Fig. 3 illustrates the complete motor with pole-changer attached, the upper incasement of the slip-rings and the protecting cover of the pole changer having been removed.

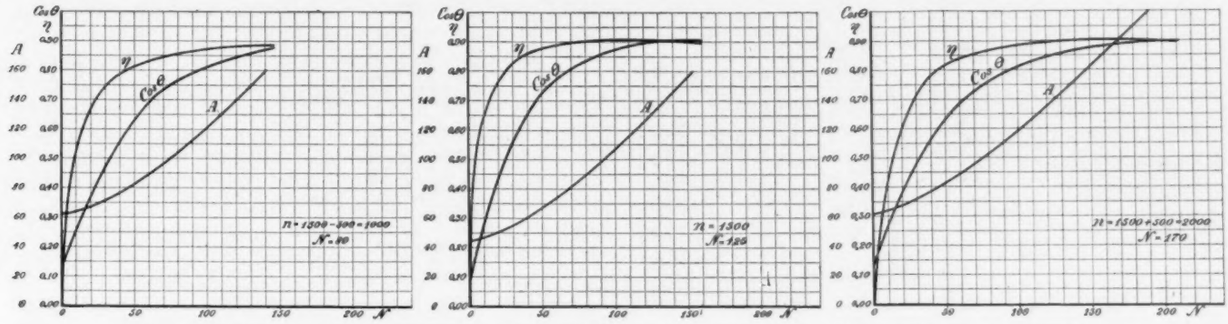


FIG. 8—VALUES OF EFFICIENCIES, POWER-FACTORS AND CURRENTS AS FUNCTIONS OF OUTPUT

The starting of the double rotor is effected in the following manner: The auxiliary motor is gradually brought to 187, 250, 375 and 500 r.p.m. by means of the pole changer 13 (Fig. 1), so that its direction of rotation will be reverse to that of the main motor. Then the auto-transformer 15 of the main motor is set on contact 1. In this position the main motor is run as a four-pole machine, receiving only one-third of the normal supply voltage. In about thirty seconds the rotor of the main motor attains the absolute speed of 1500 — 500 = 1000 r.p.m. Then the full supply voltage is applied to the motor by moving the controlling lever of the auto-transformer through position 2 to position 3, which latter is the running position for the four-pole main motor. The maximum starting current is about one-third the normal load current at 3500 r.p.m. The speeds of 1125, 1250, 1313 and 1500 r.p.m. may then be obtained by gradually resetting the handle of the pole changer 13 of the auxiliary motor to the zero—that is, the "off"—position. When restarting the auxiliary motor and running it in the same direction as the four-pole main motor, the speeds of 1687, 1750, 1875 and 2000 r.p.m. will be realized. To increase the motor speed from 2000 to 3000 r.p.m., the controlling lever of the auto-transformer 15 is set on position 4, thereby changing the number of poles of the main motor from four to two and reducing the voltage at the motor terminals to one-third its normal value. In about 50 seconds the motor attains its maximum speed of 3500 r.p.m. The voltage will then again be increased to the normal supply value by moving the lever of the auto-transformer through position 5 to position 6, which latter position is the running position at the maximum speed. The maximum current rush during the starting period equals about the normal full-load current at maximum speed. The intermediate speed steps, 3375, 3250, 3187,

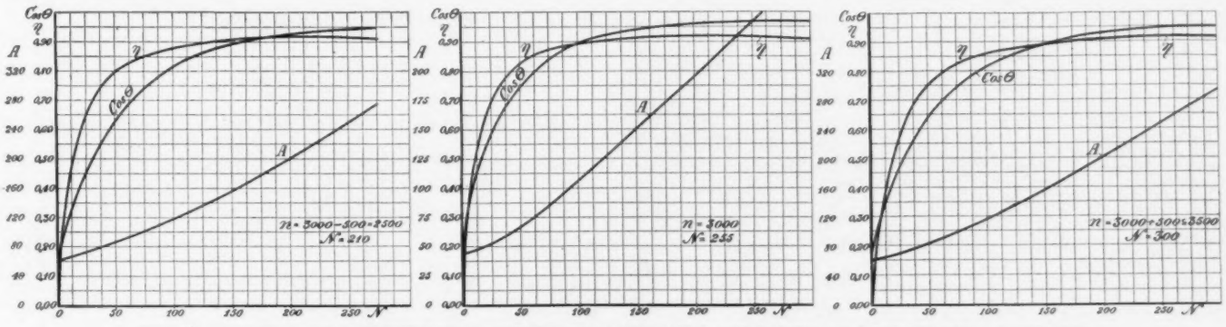


FIG. 9—VALUES OF EFFICIENCIES, POWER-FACTORS AND CURRENTS AS FUNCTIONS OF OUTPUT

Fig. 4 represents the rotor, which carries the inductor windings with the six slip-rings of the main motor and the squirrel-cage rotor of the auxiliary motor, whereas Fig. 5 shows the squirrel-cage rotor of the main motor with its two ventilators.

Fig. 6 illustrates the stator of the auxiliary motor with the two groups of magnet coils. Fig. 7 repre-

3000, 2813, 2750, 2625 and 2500 r.p.m., can now be obtained by manipulating the pole changer 13 of the auxiliary motor, in the manner described before.

Figs. 8 and 9 give the values of the efficiencies, power-factors and current as functions of the output. Fig. 8 gives these data on three of the lower speed steps—namely, 1000, 1500 and 2000 r.p.m.—resulting from

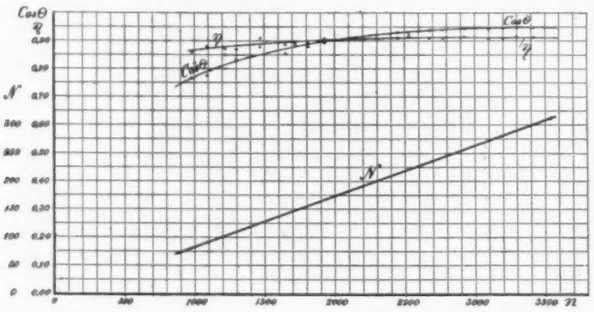


FIG. 10—VALUE OF EFFICIENCY AND POWER-FACTOR AS FUNCTIONS OF SPEED

certain combinations of the four-pole main motor with the auxiliary motor. Fig. 9 shows three speed characteristics obtained from the combination of the two-pole main motor and the auxiliary motor. In Fig. 10 the efficiency and power-factor as functions of the speed over the whole range of regulation are shown, assuming the motor running with constant torque.

If the auxiliary machine be built as a slip-ring motor, the speed can be regulated continuously by means of slip resistance. Continuous regulation may also be obtained by employing a commutator machine as the auxiliary motor.

Propagation of Wireless Waves During Solar Eclipse

The eclipse of the sun, Aug. 21, 1914, is expected to present an exceptional opportunity for the study of the propagation of electric waves through air in sunlight and in darkness and across the boundaries of illuminated and unilluminated regions. The eclipse will be total along a strip extending from Greenland across Norway, Sweden, Russia and Persia to the mouths of the Indus. In Russia the duration of totality will be a little more than two minutes.

As pointed out by the committee for radio-telegraphic investigation of the British Association for the Advancement of Science, there are two main points calling for investigation during the eclipse. In the first place, the propagation of signal-bearing waves through air in the umbra and penumbra will probably obey laws different as regards absorption and refraction from those obeyed in illuminated air. In the second place, the strength, frequency and character of natural electric waves and of atmospheric discharges may vary. The variations may occur either because the propagation of natural waves from distant sources is facilitated or impeded by the eclipse or, possibly, because the production of natural electric waves or atmospheric discharges is for some unknown reason affected by the eclipse.

These points have previously been investigated to only a slight extent. The observers of signals during the solar eclipse of April 17, 1912, nearly all agreed that the strength of the signals was greater during the eclipse than an hour before or after. There was only one special observation of strays during the same eclipse, when very pronounced and remarkable variations were recorded during the passage of the shadow-cone across Europe.

To investigate the propagation of signals across the umbra it will be necessary to arrange for wireless-telegraph stations on either side of the central line of the eclipse to transmit signals at intervals while the umbra passes between them. This transit of the umbra occupies about two minutes. It is thus very desirable that the Scandinavian and Russian stations should transmit frequently throughout several minutes before, during and after totality. Stations other than those favored by their proximity to the central line should endeavor to keep a complete record of the variations of signals during the eclipse. Stations in eastern Canada and the United States will probably be affected by the penumbra in the early morning. At Montreal the eclipse (partial) is at its greatest phase at 5.52 a. m. standard time. It is possible that the eclipse may have some influence even when it is invisible.

The investigation of strays is of as great interest as that of signals. So far as is yet known, the natural electric waves reaching wireless-telegraph stations in latitudes higher than 50 deg. appear to travel mostly from the south.

The committee of the British Association will prepare special forms for the collection of data on signals and strays during the eclipse, besides formulating a program of co-operative investigation for stations near the line of totality. Results of this study will afterward be published. Those having the facilities to cooperate in the observations are asked to communicate with the secretary of the committee, Dr. W. Eccles, University College, London, W. C., England.

Exploding Mines by Wireless

In some experiments conducted at Leghorn, Italy, to show the practicability of setting off mines by "wireless," the control apparatus was placed in a small building in a park about 2500 ft. from the two mines to be exploded. These mines themselves were submerged in the sea about 450 ft. from the shore and from 50 ft. to 100 ft. apart. Mr. Manrico Compare, inventor of the control device used, exploded the mines separately with an intervening period of about two seconds. Raised ground, trees, stone fences and buildings obstructed the space between the firing apparatus and the mines, while several wireless stations were in close proximity, but the experiments proved that the destination of the waves could be fixed without interference.

Smoke Prevention by Means of Steam Jets

According to observations recorded by the late Lord Armstrong, steam issuing from an orifice in a boiler is positively charged. Use of this principle for the dispersion of smoke has been the subject of experiments by Mr. G. B. Burnside, of the University of Glasgow, Scotland. In the course of this work aqueous vapor was projected from nozzles placed in the center of a chimney. The steam in its passage through the nozzles was electrified by friction and also partially condensed. In this way a cloud of aqueous vapor, electrically charged, was obtained in the chimney. Each particle of aqueous vapor acted as a center of attraction around which the soot particles congregated and formed groups, which fell down the chimney by gravity. In an experiment with a large school chimney 220 lb. of soot was collected in one month.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods and Current Practice Among Successful Utilities

Fourth Anniversary of Electric Shop

To commemorate the fourth anniversary of the opening of its Edison shop, the Edison Electric Illuminating Company, Brooklyn, N. Y., recently sent out attractively engraved invitations to its trade, inviting the people to visit the shop and see the new hot-weather appliances. Heretofore, in demonstrations of this kind,

INTERIOR VIEW OF EDISON SHOP

the company has set aside only one day for the event, but this time the entire week beginning May 11 was made available for the purpose. Customers were, therefore, able to examine the various electrical devices more leisurely, and they could repeat their visits and bring their friends with them. The shop was decorated with potted plants and both real and electrically lighted artificial flowers, as shown in the accompanying illustration. Cooks were kept busy preparing various palatable dishes in electrically heated utensils. Music from a cabinet phonograph and an electric piano aided in making a visit to this shop a pleasant experience. In connection with this anniversary celebration the company inaugurated a special sale of electric vacuum cleaners.

The Small Additional Cost of Ice-Making

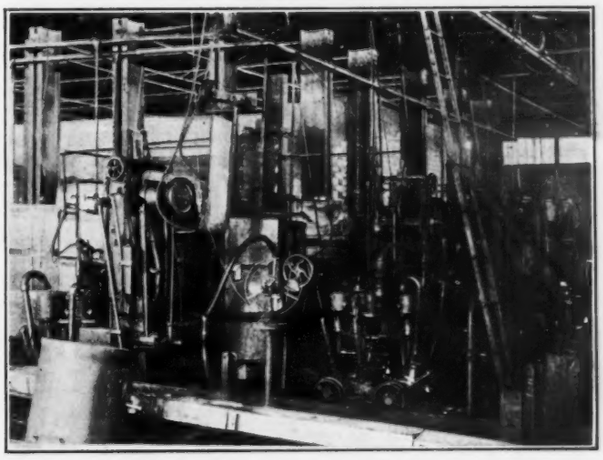
The operator of a small electric-lighting station some years ago added ice-making equipment to his plant and finds that the resulting increase in his total fuel bill has been only about 55 cents for every ton of ice manufactured by his 15-ton refrigerating outfit. During the summer months he had to hire, however, two additional tank men, each at $2 per day, thus introducing an extra labor charge of about 26 cents per ton of ice. Allowing 15 cents per ton for overhead charges and, say, 14 cents for additional expenses, replacements, repairs, etc., made during the year, the total cost of ice-making is brought up to $1.10 per ton for this combination ice-electric station. Ice made under similar conditions in a plant manufacturing ice alone would have cost from $2.25 to $2.75 per ton. The operator above mentioned finds that to operate his delivery system costs about $2 per ton of ice handled. This combination plant can, therefore, deliver to the customer's door at a cost of $3.10 per ton ice for which the purchaser will gladly pay 40 cents to 50 cents per 100 lb., or $8 to $10 per ton. Figures like the above, based on operating experience, indicate some measure of the opportunity awaiting the ice-electric plant.

A Fan-and-Feather Snowstorm

Five pounds of goose feathers, a couple of electric fans and a background set to represent a wintry day were the materials with which an effective electric-fan window display was recently made by Mr. E. A. Booth, new-business manager for the Vicksburg (Miss.) Light & Traction Company. Near the center of the window in crouching posture stood the life-size figure of a man, apparently battling his way through the swirling "snow" which drifted quite realistically about him. Signs reminded passers-by of the cooling effects of electric fans, supplementing the idea already conveyed by the striking window display.

Electricity in Glass Works

The accompanying illustration shows the plant of the Ball Brothers Glass Company, Wichita Falls, Tex., in which electricity is used exclusively for power purposes despite the low price of natural gas, 9 cents per 1000 cu. ft. The Ball factory makes fruit jars and has a



ELECTRICALLY DRIVEN MACHINERY IN GLASS-JAR FACTORY

total connected load of 115 hp in individual motor drive, its equipment including one 40-hp, one 25-hp, one 20-hp, three 5-hp and two 7-hp motors. Energy is purchased from the local plant of the Texas Power & Light Company. This glass factory was originally built to be operated electrically and has now been using service for more than a year.

Discouraging the Waste of Electricity

The Southwestern Gas & Electric Company, Shreveport, La., encourages economy in customers' use of its electric service, and to this end employs cardboard-tag reminders one of which is reproduced herewith. These tags are sent broadcast over the city at intervals of about three months and are intended to be attached to sockets and outlets containing lamps that are sometimes needlessly left turned on. Four or five schoolboys are employed to distribute the tags to the company's customers once a quarter, and each meter setter, meter reader and other employee who comes in contact with the public is also provided with a stock to be handed out to customers, affixed to installations in newly wired houses, etc. Mr. J. E. Cowles, electrical

SOUTHWESTERN GAS & ELECTRIC COMPANY'S "ECONOMY" TAG

superintendent for the company, reports that the distribution of the tags has had no appreciable effect in reducing the output of the Shreveport system. The generous spirit reflected by the company's action has, however, engendered a feeling of friendliness on the part of the public, who appreciate this evidence of the company's interest in having its consumers "get their money's worth." A direct result has been felt, too, by the reduction of practically one-half in the number of complaints of high bills brought to the company's office.

No chronic "kicker" can logically complain of his own carelessness when the company's friendly warning hangs before him all the time. The legend on the tag, it will be noted, does not omit an opportunity to remind the reader that "electric light is cheap," even though daylight be cheaper.

A 25-Ton Ice Plant That Is a 38 Per Cent Investment

A Southern town of 3000 population has a combination ice-electric plant, the ice output of which is chiefly shipped to neighboring communities, although there is a large demand for ice in the locality itself. The 25-ton ice-making equipment, including buildings, cost $17,000. It is operated five months in the year with an average gross income of $2,000 per month, or $10,000 for the year. Last season the cost of running the plant, including fuel, ammonia, sawdust, labor and the pro rata of the services of an eighteen-hundred-dollar superintendent, was $3,500, leaving a profit amounting to about 38 per cent on the original investment. A 200-ton storage compartment was recently added and aids the plant in meeting the peaks of demand for ice which come with "hot spells."

Oklahoma Rates and Revenues

Rates, revenues, expenses and other operating data of the seventy-nine central-station plants in the State of Oklahoma, compiled from the official files of the Oklahoma Corporation Commission and supplemented by personal letters and by the McGraw central-station directory, formed the subject of a paper presented before the recent Oklahoma convention by Prof. L. W. W. Morrow of the University of Oklahoma, Norman. These data are reproduced in tabular form on the opposite page.

Oklahoma rates and revenues, as pointed out by the author, are subject to conditions quite different from those in other communities because the state is of recent birth and is in the midst of a tremendous development in population, industries and resources, with resulting demands for an immediate supply of fuel, light and power.

An analysis of the data obtained from the commission's files also reveals a lack of homogeneity in methods of accounting. The larger plants and those controlled by holding companies show marked superiority in accounting methods. Their reports to the commission contain detailed statements of receipts, expenses, interest, depreciation, taxes, etc. A great majority of the smaller companies, however, lump expenses and revenues and omit all mention of taxes, interest on investment, depreciation, allowance, etc.

The rates charged for street lighting, although not reproduced here, show marked variations. The average price for 6.6-amp series arc lamps is $84 per year, and for 100-watt tungsten lamps $25 a year.

A glance at the accompanying fuel statistics shows that coal, oil, gas and wood are used, with coal predominating.

Coal at the mine costs 90 cents to $2.15 per ton, averaging about $1.70. The effect of freight rates is evident in that, although the coal is produced largely in the State, the cost delivered varies from $1.25 to $4.10, with an average of about $2.50 per ton.

Oil varies from 90 cents to $1.70 per barrel delivered and is a state product. Gas varies from 3 cents to 25 cents per 1000 cu. ft., averaging about 8 cents.

The ratio of gross receipts to operating expenses varies from 0.5 to 2.4. Eleven plants are under unity and fifty-eight above, giving a percentage of 18.7 below unity. The ratio is not large in any case, and the general conclusion may be made that the rates are low or expenses high, especially as depreciation and interest on investment are not included in operating expenses.

The data obtainable were too meager regarding interest and depreciation allowance to permit of tabulation. The larger plants and those of the holding companies allowed these percentages, but the large majority did not specify as to these items.

The private and corporation-controlled electric plants of Oklahoma have a total installed rating of 31,912 kw, varying from 30 kw to 6610 kw. The total receipts of fifty-nine plants during 1913 were $2,972,918 and the expenses were $2,058,530, leaving a balance of $914,388, or a ratio of receipts to expenses of 1.45.

The municipal electric plants of Oklahoma have a total installed rating of 6855 kw and range in size from 50 kw to 375 kw.

RATES AND REVENUES OF THE PRIVATELY OWNED CENTRAL STATIONS OF OKLAHOMA.

No.	Location	Name	Bonds	Capital Stock	Gross Receipts	Gross Operating Expenses	Plant Rating, Kw	RATES PER KW-HOUR		FUEL		Receipts per Kw of Plant Rating	Expenses per Kw of Rating	Ratio of Gross Receipts to Gross Expenses
								Residence Lighting, Cents	Motor Service, Cents	Character	Cost Delivered			
1	Ada	Ada Electric & Gas Co.	$75,500	$100,000	$33,048	$21,263	500	12 to 6	8 to 2.5	Coal	$2.90	$66.1	$42.5	1.56
2	Alva	Alva Light & Power Co.	.....	20,000	25,205	23,495	365	15 to 7½	10 to 5	Oil	$1.42 bbl	69.1	64.3	1.07
3	Aline	Aline Light & Ice Co.	.....	.....	.....	.....	.....	15	.....	.....	.....	.....	.....	.....
4	Antlers	Antlers Light & Power Co.	.....	10,000	4,524	4,792	50	15	.....	Coal	$3.15	90.5	95.8	.94
5	Arapaho	Arapaho Light & Water Co.	.....	.....	.....	.....	75	.....	.....	Oil	4½c	.....	.....	.....
6	Ardmore	Ardmore Ice & Power Co.	.....	250,000	48,831	37,374	905	16 to 8	8 to 5	.....	.....	54.0	41.2	1.31
7	Atoka	Public Service Corporation	102,000	175,000	19,830	20,296	115	15 to 10	10 to 4.5	Coal	$2 to $3	172.0	174.0	.978
8	Bartlesville	Bartlesville Interurban Ry. Co.	250,000	1,000,000	.....	.....	1075	.....	.....	Gas	5c	.....	.....	.....
9	Boley	Boley Light, Power & Mfg. Co.	.....	20,000	2,528	2,146	80	10 to 5	.....	Oil	5c	31.6	26.8	1.18
10	Broken Arrow	Broken Arrow El. Lt. & Pwr. Co.	2,000	20,000	6,065	5,254	80	15 to 10	6 to 3	Gas	5c	75.8	65.7	1.15
11	Bromide	Bromide Gas & Electric Co.	.....	.....	.....	.....	150	.....	.....	Coal	$2.10	.....	.....	.....
12	Caddo	Caddo Power Co.	.....	.....	7,200	7,200	50	15	.....	Coal	$2.10	124.0	124.0	1.00
13	Chandler	Chandler Electric Co.	.....	5,400	7,319	7,083	120	12 to 6	.....	Gas	.....	60.9	59.0	1.035
14	Checotah	Checotah Water, Light & Ice Co.	10,000	50,000	20,657	17,114	300	15 to 10	10 to 4.5	Coal	$1.95	68.8	57.0	1.21
15	Chickasha	Chickasha Light, Heat & Pwr. Co.	150,000	300,000	43,250	37,920	580	.....	5 to 2	Coal	$2.70	74.5	65.3	1.14
16	Chickasha	Chickasha Gas & Electric Co.	200,000	175,000	44,221	33,534	375	8 to 5	7 to 1.5	Water	.....	118.0	89.5	1.31
17	Coalgate	Public Service Corporation	133,000	252,000	3,340	2,631	225	15 to 10	10 to 4.5	Coal	$1.75	14.8	11.7	1.27
18	Collinsville	People's Ice & Light Co.	.....	30,000	.....	.....	185	.....	.....	Gas	54c	.....	.....	.....
19	Cushing	Cushing Electric Light & Pwr. Co.	.....	15,000	1,600	676	.....	10	10 to 5	.....	.....	.....	.....	2.36
20	Davis	Davis Electric Light Co.	.....	.....	3,889	4,000	60	18 to 12	16 to 10	Wood, coal	$2.40	64.7	66.6	.975
21	Duncan	Duncan Electric & Ice Co.	50,000	75,000	14,086	10,670	200	Flat rate	14 to 10	Coal	$3.95	70.4	53.3	1.325
22	Durant	Durant Light & Ice Co.	40,000	20,000	44,208	44,667	330	⅓c; $1.50 15 to 12	10 to 8	Coal	$2.27	133.3	135.0	.99
23	Dustin	Dustin Light & Power Co.	.....	.....	.....	.....	.....	.....	.....	Gas	84c	.....	.....	.....
24	Elk City	Elk City Light & Power Co.	.....	.....	.....	.....	115	15	5 to 2	Coal	$2.60	.....	.....	.....
25	El Reno	El Reno Gas & Electric Co.	272,200	.....	82,464	54,355	690	12 to 5	5 to 2	Coal, oil	$3.20-96c	119.0	78.6	1.515
26	Enid	Enid Electric & Gas Co.	620,000	939,300	130,846	78,038	1550	15 to 4½	10 to 2.5	Coal	$2.10	83.5	50.3	1.67
27	Eufaula	Pioneer Electric & Power Co.	.....	25,000	7,182	6,507	75	15 to 10	84	Buys energy	.....	96.0	87.0	1.10
28	Ft. Towson	Ft. Towson Elec. Light & Pwr. Co.	.....	10,000	3,137	2,959	75	15	.....	Coal	$3.00	41.8	39.4	1.06
29	Frederick	Foster-Harris Gin & Electric Co.	2,500	10,000	13,643	11,179	100	20 to 10	.....	Gas	10.5c	136.4	111.8	1.22
30	Geary	Curtis Brothers Ice & Light Co.	.....	.....	.....	.....	.....	15c	.....	Gas	.....	.....	.....	.....
31	Guthrie	Public Service Corporation	252,000	425,000	62,177	38,006	1012	15	10 to 3.5	Coal	.....	62.0	38.0	1.635
32	Guymon	Guymon Electric Light & Pwr. Co.	.....	40,000	.....	.....	75	15	10	Coal	$1.40	.....	.....	.....
33	Hartshorne	Indianola Ice, Light & Power Co.	20,000	10,000	17,534	11,944	150	15	12 to 8	Coal, oil	$2.75-5½c	117.0	79.5	1.465
34	Hennessey	Hennessey El. Lt., Pwr. & Ice Co.	1,000	25,000	5,851	5,023	115	15 to 10	5 to 3.5	Gas	5c	50.8	43.7	1.165
35	Henryetta	Henryetta Ice & Light Co.	10,000	.....	7,086	3,689	75	15 to 10	10 to 6	.....	.....	81.0	49.3	1.65
36	Hobart	Hobart Electric Co.	50,000	50,000	21,488	19,982	340	16 to 2	10 to 3	Coal	$3.11	63.2	58.8	1.08
37	Holdenville	Holdenville Ice & Electric Co.	23,000	50,000	17,797	14,420	225	15 to 10	15 to 7	Coal, oil	$2.75 $1.70	79.0	64.0	1.235
38	Hollis	Hollis Cotton Oil Co.	.....	75,000	4,225	.....	.....	18 to 13	12 to 5	.....	.....	.....	.....	.....
39	Hugo	Hugo Ice & Light Co.	20,000	50,000	59,832	43,368	360	15 to 8	15 to 8	Coal	$4.10	165.0	120.0	1.38
40	Idabel	Idabel Light & Fuel Co.	.....	.....	.....	.....	.....	15 to 9	.....	.....	.....	.....	.....	.....
41	Lawton	Lawton Railway & Light Co.	.....	40,000	.....	.....	400	.....	6 to 3	Coal	$1.25	.....	.....	.....
42	Lawton	Comanche Light & Power Co.	.....	50,000	35,711	31,983	.....	15 to 2½	9 to 4	Coal	.....	.....	.....	1.115
43	Lehigh	Public Service Corporation	15,000	25,000	385	556	.....	15 to 9	.....	Coal	.....	.....	.....	693
44	McAlester	Choctaw Railway & Lighting Co.	391,400	400,000	77,887	33,568	1480	12 to 5	.....	Coal	.....	52.5	22.6	2.31
45	Madill	Madill Ice, Light & Power Co.	.....	.....	4,714	4,345	60	12 to 10	.....	Gas	25c to 12c	80.0	72.4	1.09
46	Mangum	Mangum Electric Co.	150,000	200,000	30,286	16,268	450	.....	4c	Coal, wood	$4.00	67.0	36.0	1.865
47	Millerton	Millerton Electric Light Plant	.....	.....	496	859	15	15 to 9	.....	.....	.....	33.0	57.0	.579
48	Muskogee	Muskogee Gas & Electric Co.	1,418,000	2,198,500	495,805	301,557	3400	14 to 2.75	5.5 to 2.2	Coal, oil	.....	146.0	88.5	1.645
49	Norman	Norman Milling & Grain Co.	.....	125,000	20,972	17,669	350	15 to 6	10 to 6	Coal, oil	.....	59.8	50.4	1.186
50	Nowata	Crystal Ice & Power Co.	.....	15,000	19,051	7,969	300	11 to 8	6 to 5	Gas	6c	63.5	26.5	2.39
51	Okeene	Okeene Milling Co.	.....	10,000	3,493	2,488	60	15 to 12.5	5 to 2.3	Coal	$2.80	58.2	41.5	1.41
52	Oklahoma City	Oklahoma Gas & Electric Co.	2,863,000	2,650,000	1,100,314	740,538	6610	11 to 1.65	.....	Gas	10c	167.0	112.0	1.475
53	Okmulgee	Okmulgee Ice & Light Co.	40,000	40,000	32,537	17,576	475	15 to 5	6 to 2	Gas	10c	68.6	37.0	1.86
54	Paula Valley	Washita Electric Power Co.	33,000	250,000	13,977	7,506	375	15	5	Coal	$2.00	37.2	21.4	1.845
55	Perkins	Perkins Electric Light & Pwr. Co.	.....	5,000	.....	.....	30	.....	.....	Coal	$4.75	.....	.....	.....
56	Pittsburg	Pittsburg Water & Light Co.	.....	10,000	.....	.....	.....	12 to 6	.....	.....	.....	.....	.....	.....
57	Phillips	Public Service Corporation	.....	.....	.....	.....	.....	12 to 9	9 to 4	.....	.....	.....	.....	.....
58	Ponca City	Ponca City Electric Light Co.	20,000	20,000	.....	.....	30	.....	.....	Coal	$3 to $4	.....	.....	.....
59	Poteau	Le Flore County Gas & Elec. Co.	250,000	150,000	23,223	12,998	150	10 to 6	.....	Gas	3c	154.0	87.0	1.79
60	Pryor	Pryor Ice & Light Co.	.....	50,000	.....	.....	150	15 to 8	.....	Gas	10.5c	.....	.....	.....
61	Ralston	Ralston Elec. Light & Water Wks.	25,000	.....	.....	.....	40	.....	.....	Oil	4c	.....	.....	.....
62	Sand Springs	Sand Springs Wtr., Lt. & Pwr. Co.	.....	50,000	14,792	7,994	.....	.....	.....	.....	.....	.....	.....	1.85
63	Sapulpa	Sapulpa Electric Co.	144,000	150,000	39,652	23,975	750	12 to 6	5 to 1.7	Gas	10c	53.0	31.8	1.655
64	Spiro	Spiro Light & Water Works	.....	.....	.....	.....	300	.....	.....	Coal	$1.75	.....	.....	.....
65	Stigler	Stigler Light & Power Co.	1,500	15,000	3,422	3,988	75	15 to 5.5	7.5 to 5.5	Coal	$2.50	45.6	53.2	.858
66	Stilwell	Stilwell Water & Light Co.	45,000	45,000	.....	.....	.....	.....	.....	Coal	$1.65	.....	.....	.....
67	Sulphur	Sulphur Ice, Light & Power Co.	.....	.....	11,970	12,125	340	12.5 to 8.5	.....	Oil	68c	35.2	35.6	.988
68	Tahlequah	Tahlequah Light & Power Co.	40,000	30,000	11,090	10,248	125	15	5 to 3	Coal	$2.50	88.8	82.0	1.08
69	Talihina	Talihina Light & Power Co.	.....	5,000	.....	.....	35	.....	.....	Coal	$2.10	.....	.....	.....
70	Tishomingo	Tishomingo Light & Power Co.	.....	15,000	2,772	5,470	325	15 to 10	10	Buys energy	.....	8.55	16.8	.508
71	Tulsa	Public Service Corporation	784,000	1,325,000	22,430	13,750	2380	11 to 8	5	.....	.....	9.42	5.8	1.635
72	Vinita	Public Service Corporation	193,000	325,000	3,613	3,064	350	15 to 5	10 to 2.5	Coal	$2.50 to $2.75	10.3	8.75	1.175
73	Waurika	Waurika Ice & Electric Co.	6,200	28,300	10,688	9,704	75	15	7.5 to 5	Oil, coal	.....	142.0	128.0	1.095
74	Weleetka	Weleetka Light & Power Co.	.....	50,000	6,800	4,100	75	15	15	Coal	$2.32	90.0	54.8	1.655
75	Westville	Westville Light & Power Co.	.....	.....	2,856	2,780	60	15	12.5	Coal	.....	47.6	46.3	1.03
76	Wilburton	Dequan-McConnell Elec. Lt. Co.	.....	12,000	12,912	10,184	150	15 to 9	9 to 5	Coal	$2.50	86.2	67.8	1.27
77	Woodward	Woodward Cotton Co.	.....	55,000	10,909	13,048	100	10 to 8	7 to 4	Coal	$3.70	109.0	130.0	.84
78	Yukon	Yukon Electric Co.	.....	5,000	2,838	2,103	125	15 to 10	.....	.....	.....	22.6	16.8	1.85
79	Shawnee	Shawnee Gas & Electric Co.	776,000	863,000	195,277	165,114	1495	15 to 10	10 to 5	Gas	10c to 25c	130.3	110.3	1.18

Comfort in the Home Afforded by Electricity

Mr. Arthur William Hardigan, of the Western Electric Company, delivered a lecture in the Craftsman Building, New York, on May 12, on home comforts obtained by employing electric labor-saving devices. He called attention to the difficulty of securing servants and pointed out that industrial organizations employing girls pay wages and offer working conditions which make domestic service less desirable. Unless housework is made more attractive by installing labor-saving devices in the home the problem of securing good servants will become still more serious. By employing electric devices work can be performed more efficiently and at less expense than when manual labor is relied on. The speaker recommended that home managers follow the same policy as industrial concerns, by installing labor-saving devices wherever convenience, sanitation, comfort and efficiency can be bettered.

In commenting on the expense of doing household washing, Mr. Hardigan said that in general a laundress must be paid from $1.50 to $1.60 per day besides giving her one or two meals. Assuming that one washing is done each week, the cost would be about $100 a year, or $500 in five years, for labor alone. In addition there is the wear and tear on the goods washed caused by friction on the rubbing board. The speaker said that replacements necessary because of wear during washing cost about $80 per year in a moderate-sized family. The total washing expense, to say nothing of the inconvenience occasioned by having the work manually performed, would therefore amount to about $900 in five years.

When an electrically operated combined washer and wringer is employed hot soapsuds are forced through the mesh of the fabrics without wearing them out. As there is practically no manual labor except that of starting and stopping the machine and transferring the clothes from one place to another, a maid employed for general housework can be utilized to care for the washing.

An electric washer for a family of five costs about $85. Adding 4 per cent compound interest and the cost of supplying energy for operating the machine (at 2 cents per hour), the total washing expense in five years is about $113.85.

Another application of electricity in the home is that of vacuum cleaning. Besides being less laborious than the old method of using a broom, vacuum cleaning is more thorough, more sanitary and less harmful to the fabrics cleaned. Disease germs are liable to be carried into the lungs on dust particles, but these are not spread through the air as when sweeping with a broom. In addition, the furniture and woodwork are not covered with dust and consequently do not have to be wiped off subsequent to cleaning.

Mr. Hardigan cited a case where a 4-ft. by 8-ft. rug received the customary beating, shaking and sweeping necessary with hand cleaning. A vacuum cleaner then used on the supposedly clean rug removed two solid cupfuls of finely powdered dust, thereby showing how ineffective the old method of cleaning is. It costs about 1 cent or 2 cents an hour to operate an ordinary household vacuum cleaner.

The use of electric flatirons was compared with that of the ordinary sadirons heated on a stove. The work of ironing fifty-five pieces for a family of three (man, woman and child) was performed with stove-heated irons in four hours and five minutes. During that time it was necessary to make forty-four trips to the stove to exchange cold irons for hot ones. The same work done with an electric iron required two hours and thirty-five minutes and no exchanging of irons was necessary. Besides saving time and trips to a stove, the electric iron is much more convenient to work with because the heat is radiated in a useful direction and not into the room. In a home where 100 or more pieces of flat work have to be ironed each week it is economical to employ an electric mangle.

Among other appliances recommended for use in a moderate-sized family were exhaust fans for kitchens, motor-driven sewing machines, electric heating pads, toasters, percolators and chafing dishes.

The real work of sewing is eliminated and the operation made a pleasure when sewing machines are motor-driven. Thus equipped, a sewing machine can be operated for about 0.3 cent per hour. Electric heating pads lack the objectionable feature of hot-water bags and furnish gentle, soothing and uniform heat. They may be operated at about 0.5 cent per hour. Toasters permit of making fresh, crisp toast as it is wanted. About twelve slices can be toasted for 1 cent.

Pumping City Water by Electricity

Mr. John M. Bryant, assistant professor of electrical engineering at the University of Illinois, read a short paper entitled "Pumping City Water by Electricity" at the annual meeting of the Illinois Water Supply Association, held at Urbana, Ill. He said that electrical equipment costs about 25 to 50 per cent as much as steam-driven pumping units. It is believed that the cost of the power-plant equipment and buildings of water-works systems represents a little over 15 per cent of the total cost, new, of the entire equipment. Reducing this by 25 per cent will make the first cost something like 11.4 per cent. This will, in turn, affect the cost of operation by 1.7 per cent of the present cost of operation for the steam-driven station.

In relation to cost of operation the author pointed out that the cost of motor repairs is negligible, in comparison with those of steam-driven or gasoline-driven units. The cost of motor attendance may be made very small. There is practically no cost for lubricating oils. The maintenance item of banked boilers to be available in case of fire is done away with. Depreciation is less, as is also interest on investment, as heretofore explained. Electrical energy may be purchased (if available) at a low rate, as the load is a desirable one.

The electric motor is more reliable than the steam or gasoline engine. In order to increase the reliability of the whole system Professor Bryant made these suggestions:

"1. The motors should be placed above all possible flood levels. Although a few cases are known of motor-driven mine pumps operating under water and pumping the mine dry, the insulation is not usually guaranteed to stand such treatment.

"2. Instead of installing one large motor and pump to furnish the total amount of water for the high-pressure service at least two units, and preferably three, should be installed. When installing three units the combined capacity of any two should be able to supply the peak load of the station. This method of design allows the unit or units in operation to run without throttling and at their full capacity.

"3. When the pumping station is situated at some distance from the power plant duplicate pole lines should be installed and over routes widely separated. When the wires pass through city streets a fire in a given quarter may destroy one pole line but service may be maintained over the other line. Repairs may also be made on either line and at any time without interrupting the operation of the station."

Illumination and Wiring

Ornamental Lighting in Pacific Coast Town of 1000 Inhabitants

The town of Cashmere, Wash., is proving itself a progressive community by establishing a street-lighting system that might well elicit the emulation of a much larger place. The installation of its new tungsten street lamps covers 13,000 ft. of street, including the entire business district and the principal parts of the

FIG. 1—NIGHT VIEW IN CASHMERE'S PRINCIPAL BUSINESS SECTION

residence section. There are 131 lamps in all and they are spaced from 100 ft. to 125 ft. apart. Each standard is equipped with one 60-cp tungsten lamp, which is inclosed in a 16-in. white globe. In the business district pressed-steel lamp-posts are used. These posts are so designed that two or four globes can be added, making three or four clusters as desired. In the residence district a steel pole is mounted on a concrete base, as shown in Fig. 2. The latter was designed by City Engineer J. M. Crome.

Energy for the lighting of these lamps is obtained from the municipal plant and conveyed through lead-covered cable laid in 0.75-in. iron conduit under the concrete sidewalks. The turning on and off of the energy is accomplished by a Campbell automatic time switch. In order to obtain the maximum ornamental effect, the

FIG. 2—ORNAMENTAL POSTS USED IN RESIDENTIAL SECTION OF CASHMERE

telephone and transmission-line poles were removed to the alleys wherever possible. The cost of the street-lighting system was approximately $16,500.

It may well be doubted whether the lighting system now in operation in Cashmere is excelled by that of any other place of such small size in the whole of the United States.

Nitrogen-Filled Lamps for Interior Lighting

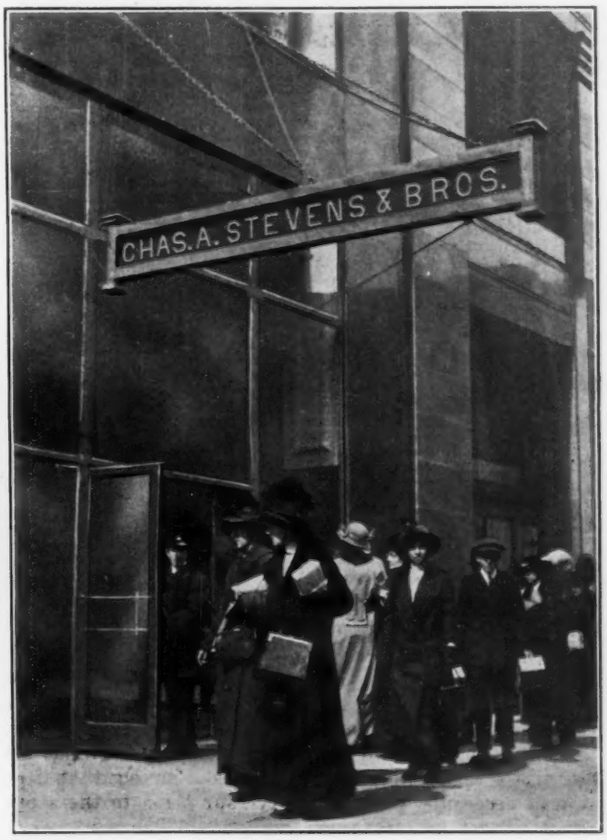
In the new portion of the Fisk Street generating station of the Commonwealth Edison Company of Chicago nitrogen-filled tungsten lamps are used for general interior illumination with success. To illuminate a floor space of 60 ft. by 200 ft. ten 750-watt lamps are used. The lighting units are suspended 50 ft. above the floor in two rows, so that they are about 33 ft. apart. The lamps have to be suspended at the considerable height mentioned in order that the traveling crane may clear them.

Light distribution from side-wall brackets or from posts is open to objection in large generating stations, and the new high-efficiency gas-filled incandescent lamps suspended from the roof structure seem to be well adapted for this purpose. In the Fisk Street installation enameled-steel reflectors are used, and to a large extent local illumination around gages, instruments, valves, etc., seems to be unnecessary.

Outdoor Miniature-Lamp Letter Sign

The sign shown in the accompanying illustration is made up of 6-in. letters illuminated by miniature lamps. It is similar to the indoor signs using 3.5-in. letters; the letters, however, are made of larger glass tubes. The filaments are like those used in the smaller lamps, but when energized are more brilliant. The sign is double-faced and is finished in natural bronze. Plate glass is placed over the lettering to make the sign weatherproof.

This sign was installed by the Federal Sign System (Electric), Chicago, Ill.



OUTDOOR SIGN ILLUMINATED BY MINIATURE LAMPS, FORMING 6-IN. LETTERS

Reducing the Cost of Line Construction

Comparative tests conducted in St. Louis, Mo., seem to show that the cost of overhead distribution line construction may be reduced to nearly one-third its former value by the use of a combination primary-secondary distribution rack. In addition to the economic record shown, the distribution rack has the further advantage of presenting a neat and finished appearance on the poles. For this reason the alley between Westmoreland and Portland Places, exclusive residence districts in St. Louis, was selected as the site for the experimental line. The site of the experimental standard line was in another part of the city. In all fairness it should be said that the standard line was built on a street free from trees and obstructions, under more favorable conditions than was the bracket line, where there were alley fences to be climbed and carefully kept lawns had to be avoided. Equal numbers of secondary services were installed on each line, making the necessary labor as nearly identical as possible.

DATA ON COST OF BUILDING DISTRIBUTION SYSTEM

STANDARD PRIMARY-ARM CONSTRUCTION

Material:	No. of Pieces
Primary arms	15
24-in. cross-arm braces	30
0.625-in. by 12-in. machine bolts	15
0.625-in. by 5-in. lag screws	15
Pins	30
Clamps	15
Square washers	30
Labor:	**Hours**
Seven piece, one and one-half hours each	10.50
Automobile	1.50

STANDARD SECONDARY-ARM CONSTRUCTION

Material:	No. of Pieces
Secondary arms	15
24-in. bracer	30
0.625-in. by 14-in. machine bolts	15
0.625-in. by 5-in. lag screws	15
Pins	60
Through-point spreaders	30
Malleable pole-back brackets	15
2-in. by 0.25-in. lag screws	60
Labor:	**Hours**
Seven piece, one and three-quarter hours each	12.25
Automobile	1.75
Extra team to haul arms	21.00
Driver	21.00

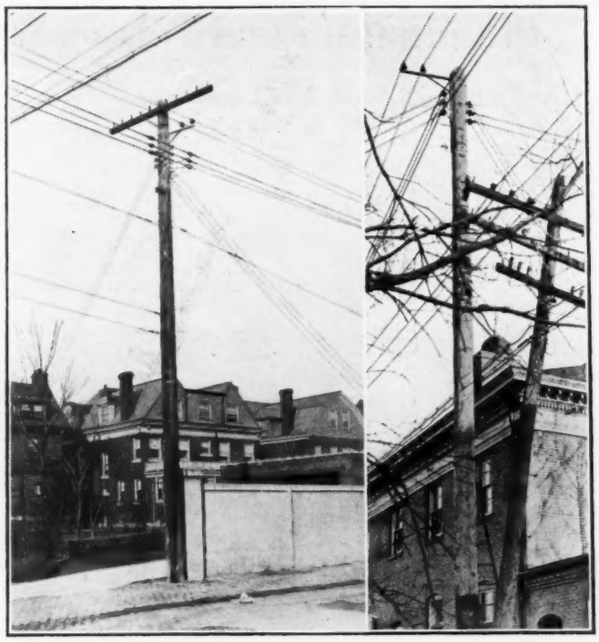
MATERIAL AND LABOR TO APPLY ON COST OF LEAD AND OIL PAINT

Material:	Amount
White lead in oil, 1 lb	10.0
Boiled linseed oil, gal	1.5
Turpentine, gal.	0.5
Japan drier, pt	0.25
Dry red mineral, lb	4.33
Labor:	**Hours**
One man painting	2.5
Two men fitting up	5.0
Total cost	$116.13

COMBINATION DISTRIBUTION-RACK CONSTRUCTION

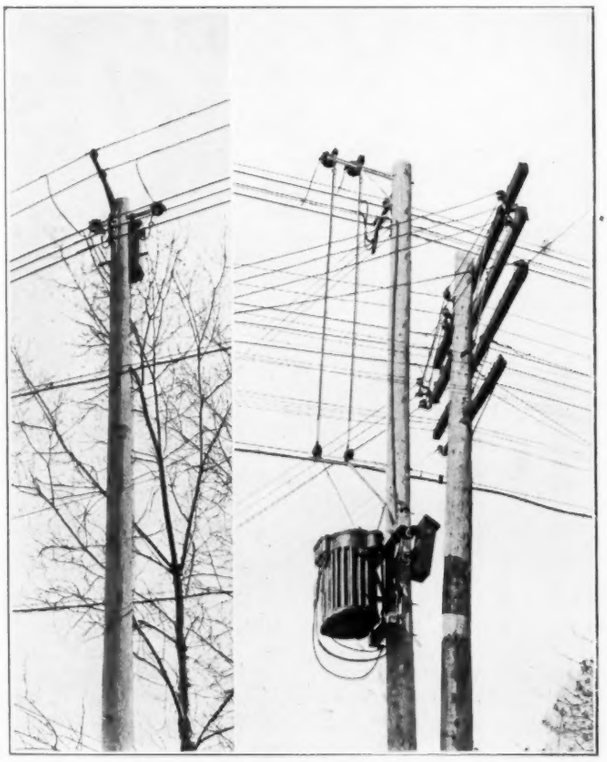
Material:	Number of Pieces
Brackets complete	15
0.625-in. by 12-in. machine bolts	30
Square washers	30
0.375-in. by 2-in. machine bolts	15
Western Union pins	30
Labor:	**Hours**
Three men, two hours each	6.0
Automobile	2.0
Total cost	$45.24

As will be noted from data in the accompanying tables, the cost of building the standard primary-secondary distribution system, inclusive of material, labor, painting, extra haulage and overhead charges, was $116.13. For the competing line using distribution-rack construction the cost was $45.24, no charge being included for extra haulage, as the crew were able to carry all material in the gang automobile. These figures show that the standard construction really cost two and one-half times as much as the distribution-rack construction, although the former was built under the more favorable conditions. Data in the accompanying tables show what material was used and give total costs.



FIGS. 1 AND 2—COMBINATION PRIMARY AND SECONDARY DISTRIBUTION BRACKET

The distribution racks, which will be marketed by W. N. Matthews & Brother, of St. Louis, consist of a



FIGS. 3 AND 4—METHODS OF HANGING TRANSFORMER WHERE BRACKETS ARE USED

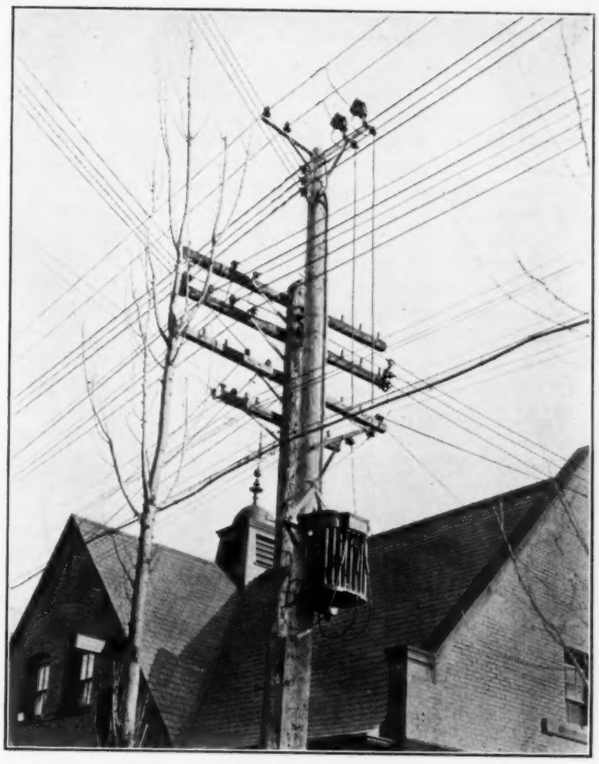


FIG. 5—TRANSFORMER INSTALLATION

combination of a channel-iron primary arm, a malleable-iron secondary rack with three pins integral therewith, and a transformer bar iron rack, all held together by one stud bolt, the horizontal or primary line arm being braced by means of a channel strut set in the right angle at 30 deg. to the horizontal member. Western Union type pins are used to support the primary line, while the secondary pins are cast integral with the vertical channel. Two through-bolt suspension has been used in St. Louis, but a single stud bolt with a lag screw in the lower hole may be utilized satisfactorily. Two views of the distribution rack are shown in Figs. 1 and 2.

FIG. 6—TYPE OF CONSTRUCTION ON COMPETING LINE

For mounting transformers where distribution-rack construction is used a special hanger (Fig. 3) has been designed. In this illustration are shown the primary taps leading to fuse plugs mounted on pins at the extremities of the triangular bar-iron transformer support. No additional pole bolts are needed, as the 0.625-in. stud bolt fastening the top of the distribution rack is also used to carry the transformer hanger, the nut being backed off and a hole in the horizontal bar of the triangular iron piece being slipped over the bolt. A lag screw driven into a hole at the lower apex of the triangle prevents motion in any direction. Fig. 4 shows another method of hanging a transformer at a lower point on the pole and also shows some of the older type of construction which is being replaced by the improved design.

Fig. 6 shows a pole of identical construction with those put up in the standard line built for comparison with the distribution rack, the only difference being that the other line was built in a private alley instead of on an open street.

Recent Telephone Patents

To Mr. Homer J. Roberts, of Evanston, Ill., a patent has been granted for a circuit and key arrangement for introducing party-line ringing. Here the special keys for party-line operation are arranged in a master set for each position, the group being wired in multiple to all the cord pairs of the position. Connection to each cord pair is effected through a key individual to that cord pair and having a locking position. The patent has been assigned to the Homer Roberts Telephone Company.

Combined Telephone and Recording Systems

A combined telephone, fire-alarm and watchman's recording system has been patented by Mr. L. W. Miller, of Rochester, N. Y., and is assigned to the National Police Signal Company. The watchman on his rounds leaves the usual record on the clock system by removing the receiver from the hook. The clock is then cut out and the call extended to the switchboard. The operator can check with the watchman. If the watchman leaves the receiver off the hook but closes the door of the box at any station, this latter action restores the circuits. The fire alarm is of the usual manual type and is operated by breaking a glass and pressing a switch. The operator sets a return signal for the sender.

An entirely different kind of recording system is that of Mr. C. J. Gustafson, of Aberdeen, S. D. He provides a phonograph arrangement for a telephone first to advise the calling party of the condition of affairs and then to record any reply or replies. This apparatus is intended for use during the absence of the owner.

Muffler to Fit User's Face

A muffler comprises the invention of Mr. A. Dare, Philadelphia, Pa. This is a cone of special contour to fit the face of the user. An air vent of special construction is the feature of novelty. This is a sort of hollow button which screws into the side wall of the muffler. A partition is arranged so that two confronting relief passages are formed, the actual outlet being through a saw slit.

Letters to the Editors

Power Bond Election in Los Angeles

To the Editors of the Electrical World:

SIRS:—In the issue of the *Electrical World* of May 9 appeared a news item, under the heading "Power Bond Election in Los Angeles," containing certain statements from "a telegram to the *Electrical World* on May 7," which form altogether a one-sided representation of conditions here. Exception must be taken to the statement attributed to Mr. J. A. Lighthipe, that "the plant of the city cannot be finished for the amount estimated." Mr. Lighthipe no doubt made such a claim and submitted figures in support of his claim, but the City Council of Los Angeles employed three independent and competent electrical engineers—Prof. C. L. Cory, of the State University; Dr. George L. Hoxie, consulting engineer of New York City, and Mr. C. W. Koiner, manager of the Pasadena Municipal Plant—in November last to make estimates and report regarding installation and operating costs of an appropriate and modern electrical distribution system for the city of Los Angeles, which report shows that the statements of the city's engineers are conservative, while the claims of the local electrical companies are about 50 per cent in excess of such figures.

The statement that the writer "admits the insufficiency of the estimate" is in error, if it is intended to refer to the estimate for completing the generating works, and is wholly misleading if it refers to the estimate for providing a system for the distribution of the city's electrical energy. This is shown by the accompanying report addressed to the Los Angeles Board of Public Works, upon request, during the bond campaign, and signed by Mr. William Mulholland, supervising engineer; Mr. E. F. Scattergood, chief electrical engineer; Profs. W. F. Durand, O. H. Ensign and Harris J. Ryan, board of consulting engineers. This report was called for by a citizens' publicity organization, "the people's power bond committee," and was desired because of the misrepresentations of the local electrical companies in their talks and literature, and it contains a brief statement of the whole situation, which should be convincing as being prepared and signed by four engineers, every one excepting the writer being of national reputation.

While it is correct that "entire pages for advertisements" were used in the daily newspapers, as stated in your issue of May 9, it should have been made plain that this activity was displayed by the electric companies and not by the people's power bond committee. It should have been stated that the people's power bond committee was made up of 100 representative citizens, men and women, appointed by and representing many of the most prominent civic bodies and clubs in the city, including, among others, the Chamber of Commerce, the Friday Morning Club (women's), the Municipal League, the Central Labor Council and the City Club.

For eighteen months the municipality has attempted to work out an agreement with the private interests in order to enable the city to realize proper benefits from its aqueduct development and the municipal distribution of the same, by the utilization of the existing distributing systems. The city offered to lease all of the existing systems for a period of five years, in order to give the companies ample time in which to adjust their affairs, and to purchase, at the end of the lease, at a rental and price to be fixed by the State Railroad Commission. The electric companies having refused to enter into such an arrangement as to lease and purchase, the city is now undertaking to acquire the property by condemnation, the price to be fixed by the State Railroad Commission, in accordance with the State law.

E. F. SCATTERGOOD,
Chief Electrical Engineer,
Bureau of Los Angeles Aqueduct Power.

Los Angeles.

[The report referred to is printed in full below.—EDS.]

LOS ANGELES, CAL., May 4, 1914.

To the Honorable Board of Public Works, Los Angeles, Cal.

GENTLEMEN: The following is presented in response to your request for a statement by your engineers of the Bureau of the Los Angeles Aqueduct Power:

Power Fund Expenditures to Date.—The proceeds derived from the bond issue of $3,500,000 have been expended as follows:

Waterways leading to San Francisquito Power Plant No. 1	$480,000
Waterways leading to San Francisquito Power Plant No. 2	1,304,000
Hydraulic and electric machinery and equipment for Plant No. 1 and receiving substation, of 37,500-hp capacity	766,000
Construction work on same	624,000
Transmission line surveys, rights-of-way and equipment	326,000
	$3,500,000

Completion of Generating System.—Of the proposed $6,500,000 bond issue, $1,250,000 will complete the generating works now under construction for delivering the 37,500 hp at a central substation in the city and will be used for such purpose in the following amounts:

Waterways leading to the No. 1 and No. 2 plants	$315,000
Generating Plant No. 1 and receiving substation	480,000
Transmission lines and rights-of-way	455,000
	$1,250,000

Acquisition of Distributing System.—The remainder of the proposed bonds, $5,250,000, will be used to provide a system for the distribution of the city's power. The city attorneys advise, and the Council has declared in favor of, acquiring existing distributing properties by condemnation, at prices fixed by the State Railroad Commission. Such a policy would insure to the companies a fair compensation for their properties, and though the cost would be greater than that of installing an independent system, it would eventually eliminate all competition and thus enable the city to realize greater benefits in rates and profits.

It is impossible to know what values the State Railroad Commission would fix, but the proposed bonds should unquestionably provide for proper street lighting throughout the city and for the acquisition of the complete distributing system of the Southern California Edison Company, which would serve the city's immediate purposes better than either of the other two systems.

This would insure to the city 55 per cent of the total business immediately upon the issuance of the distributing bonds, would insure reduced rates alike to all classes of consumers in every part of the city, would eliminate taxes for power bonds, and would yield a large annual net profit from the start, which could be applied to interest payments on aqueduct bonds, thus further reducing taxes, or to the extension of the electric system.

Under such circumstances the acquisition of the other systems, as needed, to cover the whole city, whether by bonds or surplus, or both, would be wholly taken care of by the business, without one dollar of additional taxation.

Net Profit from Sale to Companies.—Should the power companies contract to purchase the full output of the city's 37,500-hp plant at 0.65 cent per kw-hr. (which is the highest price ever suggested by them),

the annual net profit to the city would be but $130,000. Furthermore, the wording of the companies' proposition is such as not to guarantee to the city that they will take any power whatever.

Net Profit from Municipal Distribution.—The yearly net profit to the city from the distribution and sale by the city of the power from this same plant, at present rates, for domestic and commercial light and power and street lighting would be $1,300,000. Or, should the city distribute and sell the same at rates averaging 10 per cent less than those proposed by the city's Board of Public Utilities for the coming year, an annual net profit of $750,000 would be realized. In either case the combined benefits in rates and profits would be the same.

Equal net profits and benefits are shown by the special board of electrical engineers employed by the Council in November last. Respectfully submitted,

WM. MULHOLLAND, *Supervising Engineer.* E. F. SCATTERGOOD, *Chief Electrical Engineer.*
W. F. DURAND, O. H. ENSIGN, HARRIS J. RYAN, *Consulting Board of Engineers.*

Co-operation Essential in Conciliation

To the Editors of the Electrical World:

SIRS:—In his letter relative to "The Attitude of Conciliation," which appeared in the *Electrical World* April 25, Mr. S. M. Kennedy brought out some very good points with reference to relations between public utility companies of to-day and their patrons. There are certain other suggestions of value which would aid materially in producing courteous treatment of the public by employees which he did not bring forward in his letter.

No doubt the attitude of conciliation on the part of corporation employees will accomplish wonderful results toward gaining the confidence of the public in general; but, as "charity begins at home," why not broaden the scope of this attitude so as to make it applicable among employees in their dealings with each other?

The attitude of conciliation as applied to employees dealing one with another may be compared to the advancement of the electrical science of present-day lighting. By reflection, indirect lighting produces a soft, mellow light, evenly diffused, which is pleasing to the eye and does not produce the glare found with direct lighting. So a spirit of co-operation and courteous treatment among superiors and subordinates in public utility companies reflects a certain influence which is productive of true conciliation, "the kind that flows from the heart," in their dealings with the public and commands public confidence.

The success of any enterprise depends largely on the personnel of the organization and the amount of co-operative spirit existing among the individuals composing the operative force of the enterprise. Perfect harmony should exist in the organization of utility companies in order that a harmonious influence may exist between employees and the public. Courtesy practised in ever-day transactions soon becomes a habit which is far-reaching in its influence toward gaining public confidence. Therefore, in answer to Mr. Kennedy's question as to "how to spread the gospel of conciliation among company employees," the writer suggests that, by precept and example, they be permeated with courteous cheerfulness and thereby impressed with the knowledge of what the word "conciliation" stands for and its importance to them and the organization of which they are a part.

There is another phase of importance which should not be overlooked in discussing "the attitude of conciliation." The burden of responsibility for existing conditions should not be shifted too heavily on the shoulders of those employees alone who are in direct contact with the public. Certain influences are exerted by the dealings between executive departments of utility companies and individuals who officially represent the public which also have an important bearing on the situation.

An attitude of conciliation on the part of company officials which is not reciprocated by public officials becomes monotonous and is not productive of the harmonious relations which should exist between the companies and the public, whose interests are mutual.

Utility officials, as a rule, are always conciliatory in their treatment of their patrons, but self-preservation and respect sometimes require that they assume a defensive attitude toward public officials, who, in their eagerness to gain political advantage, are apt to confound the meaning of the word "conciliation" with that of "humiliation." It is just as essential that a spirit of co-operation exist between private and public officials as it is for employees to maintain an attitude of courtesy in their dealings with the public; in either event a discord upsets the melody of conciliation. It is the writer's opinion that co-operation is the keynote to be sounded in attuning harmonious relations between the public utility companies of to-day and the public in general.

Redondo Beach, Cal. J. M. LONG.

Economics of Power-Factor Adjustment

To the Editors of the Electrical World:

SIRS:—The proposal of Mr. H. B. Dwight in the *Electrical World* of March 28, 1914, for improvement of the power-factor deserves the fullest consideration. Difficulties might be encountered when attempting to reduce his plans to practice, however, since the user is not anxious to buy expensive synchronous motors, phase advancers, compensators, etc., and to take care of their maintenance and attendance. Three-phase commutator motors, which are used to a considerable extent in Germany, have a better power-factor, but are more expensive, than induction motors of the same rated output, and they are inferior to direct-current motors with respect to speed regulation.

The author's proposal that, instead of paying for real consumption in kilowatt-hours, the consumer should pay for his complex consumption in kilovolt-ampere-hours—as proposed, for instance, by Arno and Benischke—is also objectionable in practice. Attention has been called repeatedly to the great industrial importance of improving the mean power-factor evaluated with respect to time. This goal can best be reached by the use of the synchronous motor. The problem will be solved in practice, however, only when the construction of the synchronous machine has been simplified.

Above all things it would be necessary for the synchronizing operation, starting and regulation to constant power-factor to be independent of the attendant; that is, automatic. That this goal can be reached in practice is obvious from an article on "The Attendantless Rotor Converter Substation at Detroit" in the *Electrical World*, June 28, 1913. Attention should be directed also to articles on "Combined Synchronous and Induction Motor Loads," by Messrs. H. L. Wallau, *Electrical World*, Nov. 22, 1913, and G. W. Meyer, *Electrical World*, Feb. 14, 1914.

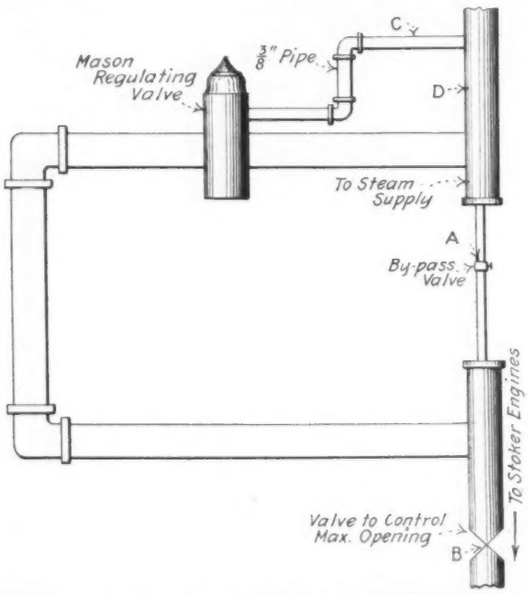
Zwickau, Germany. GUSTAV W. MEYER.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Regulating Valve Controls Stoker-Engine Speed

An ingenious piping layout, including a regulating valve, has been constructed in the power station of the Springfield (Ill.) Light, Heat & Power Company for controlling the speed of the stoker engines and hence maintaining practically constant steam pressure. Referring to the accompanying diagram, the valve *A* is set to allow the flow of enough steam to produce the minimum desired speed of the stoker engines. Likewise, the valve *B* is set to control the maximum speed of these engines. As the steam pressure in the supply main *D* increases the variation is transmitted to the diaphragm of the regulating valve by means of the small 0.375-in. pipe shown in the sketch. This change in pressure tends to close the valve reducing the flow of steam to the engines. On the other hand, if the steam pressure falls the regulating valve allows an increased flow of steam through the lower valve, forcing the fires and bringing the steam pressure to the desired point. Attention to setting the valves in the piping system saves the boiler-room force many steps and much time which would otherwise be required in manually regulating the speed of the engines driving the chain-grate stokers.



PIPING LAYOUT FOR CONTROL OF STOKER ENGINE

Elevator Limit Switches

Good chemists are not expected to know much about freight elevators, motors and such things; if they did, they probably, and logically, would not be such good chemists. The air-gap and bottom of an induction motor were found to be full of "babbitt." Under the assumption that a chemist should know babbitt from solder, the repair shop would have sent him a set of rotor bearings and let it go at that; but this repair shop was not taking any chances with a motor that it had recommended. When the inspector got there the motor had been disassembled, and a glance at the bearings revealed that they were all right, but the stator coils were lined with a bright metal which proved to be about all of the silver solder that the rotor connections ever had in them. The sum total of the information forthcoming was to the effect that the rotor "sparked when she was running," though the elevator "never had been overloaded." It later developed that owing to the absence of any limit switch to limit the upward travel of the elevator a green operator had, about a week before, tried to run the elevator through the roof. Failing in this, the roof being too strong, he became scared and jumped off, leaving the motor to hum and buzz until its fuses blew, but too late to save the solder. The elevator now has a very nice four-dollar limit switch, and it should be pointed out that hoists of all kinds should have limit switches, as much to guard against the effects of controllers getting stuck as against the effects of careless operation.

A Differential Relay for Heavy Work

BY HARRY E. DEY

Some time ago the writer had occasion to use a differential relay that involved unusual requirements inasmuch as it had to be very sensitive, operating upon a small fraction of 1 per cent of change in current, and was used for closing and opening a pilot motor circuit (0.0825 hp) every few seconds, the motor running in two directions.

A prominent electrical instrument manufacturer had previously reported that he could provide nothing, either special or from stock, to fulfil the conditions, as the design of his instruments necessitated that the spring should be a conductor, while the current requirements involved were too great for this service. Upon further investigation the writer came to the conclusion that it was necessary for him to design some device to be made in the shop. Before entering upon a description of the device built it may be well to give a general idea of the purpose for which it was intended.

A 40-hp motor of special design and construction was installed on a United States cruiser for steering purposes. This motor was controlled for speed, direction and stoppage by means of a field rheostat only. Mounted on a standard on the bridge of the ship was a bronze case which contained a small high-resistance rheostat (*a* in Fig. 1), which was operated by means of a hand wheel *b*, the shaft of which passed through the case. A line wire was connected to the contacting finger, which was normally at the center of the commutating arc, thus giving equal resistance to each side. Down in the steering room a duplicate of this rheostat *c* was connected with the finger of the steering-motor field rheostat in a manner to cause them to move together. The differential relay was also installed in the

steering room. Two wires connected the extremes of the arc of one rheostat to corresponding points of the other rheostat, the coils *d* of the differential relay being inserted in the circuits between the two rheostats in such a manner that the two windings opposed one another.

If the helmsman desired to turn the rudder, say, 5 deg. to starboard, he would turn the hand wheel until the index to which it was geared pointed to 5 deg. starboard. This would upset the equilibrium of the relay circuit, causing its pendulum to swing over to starboard and close the pilot-motor circuit. The latter would immediately operate, moving the arm of the field rheostat to a position that would cause the steering motor to run in the proper direction to carry the rudder to starboard. The pilot motor, besides changing the field rheostat, drove the contacting finger of the relay rheostat to a position which would neutralize the change of resistances in the rheostat on the bridge. This again balanced the two circuits, allowing the relay pendulum to swing to the center and thus break the pilot-motor circuit. If the pilot motor overran from momentum, the relay would become unbalanced and thus swing over to the other side and reverse the motor. The overrun would be so short, however, that the motor would not have enough momentum on the return to pass over, consequently no brake was required. The net result was, therefore, a slight overrun, a rebound and a dead stop.

When the steering motor operates, in addition to moving the rudder, it drives, through a chain of gearing, the field rheostat body in the base of the machine. This rheostat body is driven in the same direction that the contact finger was moved, so that by the time the rudder has reached the end of its 5-deg. travel the relative positions of the finger and the body are unchanged from what they were before the helmsman acted. An overrun of the steering motor from momentum acts in a similar manner to that with the pilot motor, unbalancing the field rheostat and causing the motor to rebound with an easy elastic movement and to stop at the point required. It was interesting to watch this motor with its slow elastic movements for small changes and quick rotation for the greater rudder movements.

Connections of the Relay

The relay, as illustrated herewith, is made from a brass spool 4 in. long and with heads 4 in. in diameter; the hole is 1.75 in. in diameter. After providing the proper insulation the spool was wound with two parallel insulated wires separated by a coarse thread. The four terminals were brought out to binding posts, which were later connected to the circuit in such a manner that the currents oppose one another. This causes a high difference of potential between the adjacent wires near their terminals, consequently extreme care is required in the winding. Each layer should be especially well insulated from the layer beneath. This parallel winding provides an absolutely accurate balance that can never be secured by winding the two circuits in separate coils. A brass shell slipped over the spool completes the metal housing. A hard-rubber plate is attached to one of the heads, for holding the binding posts, and the whole is fastened to a base plate by lugs as seen in Fig. 2.

Another brass spool was made to provide a snug fit in the first spool when forced in with its axis at right angles to the former. It is held from endwise movement by means of rods suspended from the binding-post plate which is mounted on top of the main spool. This spool is wound with a single insulated wire of a resistance sufficient to take care of the full line voltage, for it is connected directly across the circuit. A wide deep groove is cut across each head of this spool, extending lengthwise of the main spool. A soft-iron core, having considerable clearance within the hole of the spool, is mounted upon pivots at the center, the clearance permitting a slight rocking motion up and down. This core is shouldered and threaded at the ends. An elliptically shaped ring is sprung over the ends of the core, when assembling, and held in place by thin iron nuts, the latter also serving as pole pieces.

It will be noted that none of the wires has any motion, and also that the iron core is traversed by a constant number of magnetic lines regardless of the balanced or unbalanced condition of the differential coils. In other words, it is equivalent to a permanent bar magnet, the only object of the winding being to obtain additional strength of magnetism. Owing to this fixed magnetism there is no magnetic lag and consequent loss of sensitiveness, as would be the case were the changing magnetism of a piece of iron depended on. With this design the slightest unbalancing of the currents of the outside spool is at once manifested.

A pendulum rod is attached to the lower part of the

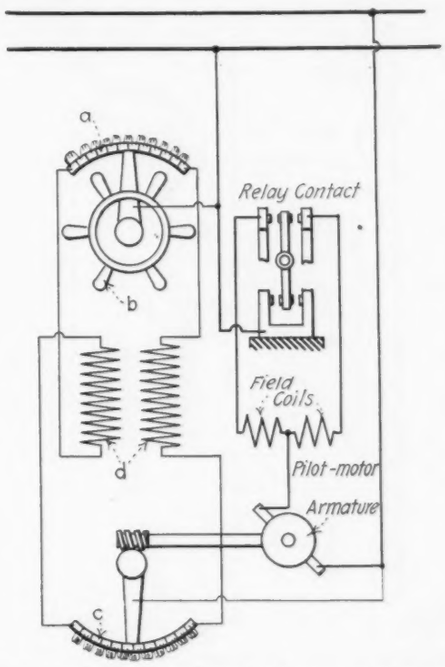


FIG. 1—CONTROL CIRCUITS FOR ELECTRIC STEERING

elliptical ring, while a ball serves as a counterbalance at the top. The lower end of the rod is turned off to form a shoulder and to provide a bearing for a bar about 1 in. long loosely mounted thereon. This bar is provided with platinum contacts, four in number, set upon opposite sides of its two ends. Corresponding contacts are set upon brackets mounted upon the base of the instrument. Two of these latter contacts are electrically identical, being attached to a bracket common to both. The double-contact bracket is connected directly to the line while the single contacts are led to the pilot motor. The contact bar acts as a bridge between the double-contact bracket and one or the other single contacts, thus obviating any flexible connections between moving parts and also providing a double series break when opening the circuit. This greatly reduces the arc and also acts as a safeguard against sticking, for if one side did stick there would still be enough hinge action to allow the other side to open the circuit.

One problem that caused considerable difficulty was that of obtaining a spring to bring the pendulum to its neutral or center position and which would at the same

time be practically frictionless. Another desirable feature in the spring was to have it decrease its pulling power as it left the neutral point so that by the time the contacts were reached there would be very little pull remaining, and thus the electrical contacts would be proportionately improved. These requirements are directly opposed to the principle of action of any mechanical spring, but the happy thought finally struck the writer of using a permanent steel magnet for a spring. The magnet included both the important elements of being frictionless and having the pull decrease with the distance moved, besides being easy to adjust by filing off the small wire used as an armature. The device as finally built consisted of a specially designed magnet, cut out of sheet tool-steel and hardened, of the form shown in Fig. 2. It will be noted that the pole pieces are sharply pointed, like the teeth of a saw, and are separated by about 0.25 in. The magnet is fastened to the insulating block in a position that will permit the pendulum to swing between the pole pieces without touching them. The pendulum at this point is drilled to receive a small iron wire, which passes through and is pointed at both ends. It is made short enough to afford a liberal clearance when passing between the poles. In operation the poles draw the iron wire, and hence the pendulum, to the exact center and hold it there with all the force desired. This magnetic spring completely solved the problem and it appears that there may be other cases where it might be used to advantage.

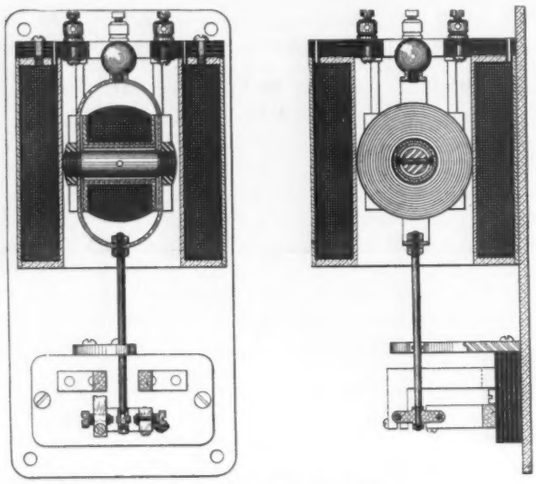


FIG. 2—CONSTRUCTION OF DIFFERENTIAL RELAY FOR HEAVY WORK

Before the sea trials the writer feared that the pendulum might vibrate, owing to the rolling and pitching of the ship and the vibration of the machinery, and thus keep up a continuous "seesawing" of the steering, for the magnetic spring had to be made quite weak in order to preserve the sensitiveness of the relay. But, as usually happens, the expected difficulty did not come to pass, and in the worst of seas the pendulum never wavered.

The Pilot Motor

Another problem that came up in this steering device was that of reversing the pilot motor without the complication of a pole-changing switch on the relay. This was accomplished by providing the field with two sets of windings. Two terminals, one from each winding and of opposite signs, were joined together to one of the commutator brushes (see Fig. 1). Of the other two terminals, one was connected to one of the relay contact points and the other to the remaining contact. The other commutator brush was connected to the line. The resultant operation was that when the relay closed one circuit it sent the current through one set of field coils and thence through the armature in series. When the circuit was closed through the other contact the current passed through the other field coil in the reverse direction, which reversed the field, and thence through the armature in the same direction as formerly. This gives a reversing motor with only a single contact required for each direction. There are many cases where a control of this kind can be made to fit in to advantage.

The motor used was of standard manufacture and of the fan-motor type, but its builders refused to take any responsibility if they provided it with two fields. The writer lost patience with their ultra-conservatism, had the old field coils removed and replaced them with new ones of enameled wire. The saving in space due to using this enamel conductor in place of the former cotton-covered wire permitted almost as many ampere-turns for each coil as there were in the original windings. The motor never gave the slightest trouble. Without any external resistance it was thrown on, back and forth, every few seconds, for periods sometimes extending over several days.

Conversion of a Single-Phase Generator Into a Motor

Can a 45-kw, 2200/1100-volt, 133-cycle, single-phase, 1200-r.p.m. generator be converted into a motor? If so, what speed and power can be obtained? P. T. O.

Any generator may be operated as a motor, but when designed for single-phase operation it is usually necessary either to change its internal construction or to provide some external means of bringing it up to speed. If the generator is of the revolving-field type, it would not be difficult to make three-phase taps on the stator winding and bring the motor up to speed with "split-phase" current. In general it is preferable to accelerate the motor to synchronous speed by some external source, using either a directly connected or a belt-drive motor. At 133 cycles the machine will run at 1200 r.p.m. and develop about 35 hp. At lower frequencies the speed and operating voltage will be correspondingly decreased and the permissible load reduced proportionately.

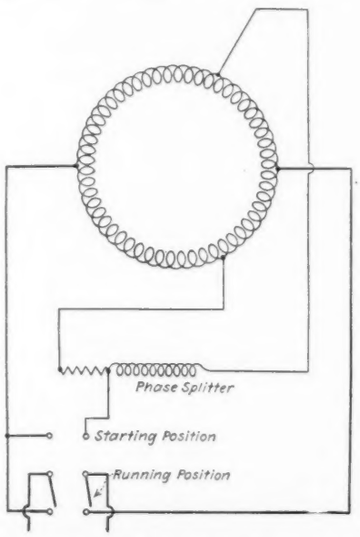


DIAGRAM SHOWING WIRING SCHEME FOR CONVERTING A SINGLE-PHASE GENERATOR INTO A MOTOR

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Static Transformers for the Simultaneous Changing of Frequency and Pressure of Alternating Current.—A. M. TAYLOR.—An illustrated paper read before the Birmingham Section of the (British) Institution of Electrical Engineers. The author first mentions the frequency changers of Joly, Vallauri and Spinelli. The principle of the present author's arrangement is shown

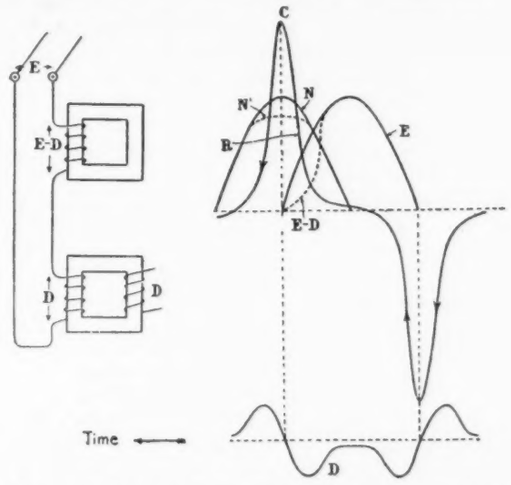


FIG. 1—PRINCIPLE OF TAYLOR'S ARRANGEMENT

in Fig. 1. In this the connections are shown that would obtain if the arrangement were single-phase. Consider first what would happen in the choking coil if the primary winding of the working transformer were short-circuited, which condition would exist if the saturated choking coil were connected directly to the supply mains. The wave-form of the current which would then flow is shown by curve *C* in Fig. 1. It will be seen at once that if the current took this form the portion of the curve marked *R* would be that on which the rate of change of current was very rapid; and, in

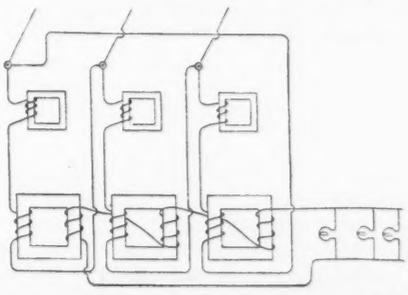


FIG. 2—CONNECTIONS OF FREQUENCY CHANGER

consequence, if the current undergoing this change could be passed through the primary coil of a transformer winding, on an unsaturated core, so that the flux virtually followed the current wave, the emf in the secondary-coil windings on the core of this transformer would have the wave-form marked *D* at the bottom of the figure. This, however, would leave a large period of the fundamental cycle in which no useful work was being done in the secondary coil of the transformer, and it would be an unsatisfactory arrangement. Another disadvantage would be that the half-waves of the emf would not be exactly symmetrical, because the

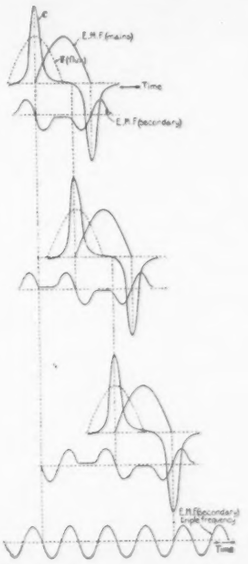


FIG. 3—COMBINING THREE PHASES TO FORM SINGLE PHASE

ascending and descending sides of the peak of the current are not exactly symmetrical about the axis. If, however, the arrangement is repeated on the three phases as shown in Fig. 2, these two difficulties disappear, the blank spaces being filled in by the impulses received from the other phases, and the dissymmetry of

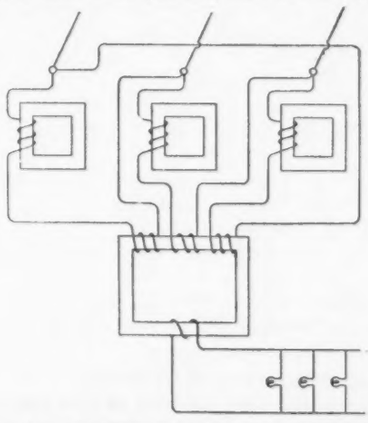


FIG. 4—PRESENT FORM OF ARRANGEMENT

the positive and negative half-waves of emf being nullified by corresponding impulses from other phases, in the manner indicated by Fig. 3. A further investigation of the wave-form obtained in the secondary circuit (Fig. 3) shows that at any instant only two out of three transformers are active, and the question then arises whether it is expedient to couple the secondary

coils in series or in parallel. The author decided that it would be better to couple them in parallel than in series. It is desirable to avoid difficulties with the idle current in the third phase by having a single winding in the secondary, and by employing a common magnetized core, which is magnetized by the three primary currents having peaked wave-forms as received from their respective choking coils. This is shown in Fig. 4. The application of this frequency changer to wireless telegraphy is also discussed. In an appendix the author shows how the power-factor, which is only of the order of 0.2, can be compensated for. One use of the apparatus would be the conversion of three-phase current on systems having a frequency of twenty-five cycles per second to single-phase triple-frequency currents having a frequency of seventy-five cycles for lighting work. At the meeting Mr. Taylor performed an interesting experiment to show the reversibility of the apparatus, which consisted in passing through a special transformer a current received at seventy-five cycles and obtaining from the said transformer a current of twenty-five cycles.—London *Electrician*, May 8, 1914.

Air Filters.—O. GEROLD.—An illustrated description of details of construction of air filters built by a German company for removing the dust from the air for cooling turbo-generators.—*Elek. Zeit.*, May 7, 1914.

Lamps and Lighting

Street-Lighting Specifications.—JACQUES ABADY.—The author deals with the subject of street lighting in relation to the standard specification proposed by the joint committee of the Institution of Electrical Engineers, Institution of Gas Engineers, Institution of Municipal and County Engineers and the Illuminating Engineering Society, as given in a paper read last year by A. P. Trotter before the last-named society. A number of clauses are here proposed, and it is suggested that the necessary photometric measurements should depend upon rays making 20 deg. and 50 deg. respectively with the horizontal, the candle-power of the former to be at least 15 per cent greater than that of the latter.—London *Electrician*, May 8, 1914.

Street-Lighting Specifications.—An editorial commenting on Abady's article (mentioned in preceding abstract). The committee had arrived at the conclusion that the only quantity that needed specification was the minimum horizontal illumination observed upon a plane 3 ft. 3 in. above the surface of the street. Abady was one of the keenest opponents of the suggested clauses at the time of the discussion. The writer agrees entirely with Abady when he says that one of the objects of such a specification should be to allow fair competition by all systems of illumination. There is, however, some difficulty in securing this desirable end. The difficulties become less when dealing with illumination rather than candle-power, but Abady objects to an illumination standard. The editor thinks that the recommendation of the joint committee was strong, but did not go far enough, and that the ratio of maximum to minimum illumination cannot be wholly neglected. As against the measurement of minimum illumination, Abady prefers to measure the candle-power along the 20-deg. and 50-deg. rays from the horizontal, and he suggests that the former should be 15 per cent greater than the latter, as it is the more important. In this respect it is thought that Abady does not go far enough. If candle-power measurements are to be made in place of illumination measurements, then the 20-deg. ray should have a much greater relative importance. The aim of the street lamp should be to throw the illumination as far as possible into that region which is situated about midway between the lamps. From this point of view it would be better to take the 15-deg. ray instead of the 20-deg. ray. Considering that the ray with the smaller angle would generally have to travel more than twice as far as the ray with the larger angle, it would not be too much to suggest that the 15-deg. ray should, preferably, have double the candle-power of the 50-deg. ray, instead of an excess of merely 15 per cent.—London *Electrician*, May 8, 1914.

Low Candle-Power Half-Watt Lamp.—R. ZIEGENBERG.—By means of small transformers, nitrogen-filled tungsten lamps consuming half a watt per candle-power can be applied in low-candle-power units for alternating-current supply networks. A German company brings half-watt lamps of the following sizes on the market in spherical form:

Diameter	Candle-Power	Volts
70 mm (2¾ in.)	50	14
80 mm (3⅛ in.)	100	14
100 mm (3 15/16 in.)	200	25
120 mm (4¾ in.)	400	50

The transformer is either built directly into the fitting of a single lamp or one transformer is used to supply energy to several lamps near together. Since the lamp consumes 0.5 watt per candle, and the efficiency of the transformer even in the smallest sizes is between 88 and 97 per cent, the practical specific consumption of the lamp is 0.6 watt per candle. If the cost of electrical energy is 10 cents per kw-hr. it is estimated that for 1000 hours of burning a saving of 40 per cent is obtainable with a 50-cp lamp and a saving of 45 per cent with a 100-cp lamp, taking into consideration the cost of renewal of the lamps and the amortization of the transformers.—*Zeit. f. Beleucht.*, April 30, 1914.

"Reflex Light Tubes."—By inclosing tube lamps in a long cylindrical glass tube and inserting also a metallic reflector within the outside glass tube a good illumination for special purposes is available, especially for indirect illumination of ceilings.—*Zeit. f. Beleucht.*, April 30, 1914.

Objective Photometer.—VOEGE.—His complete paper, with illustrations, presented before the German Illuminating Engineering Society, on the use of the photo-electric cell for an objective photometer, as described in the Digest last week.—*Zeit. f. Beleucht.*, April 20, 1914.

Traction

Subway in Buenos Aires.—E. E. WACHSMANN.—On Dec. 1, 1913, a subway line from Plaza de Mayo to Plaza Once de Setiembre was opened. It is the first part of a rapid-transit system which has been designed in connection with the street railway network and which is to be completed during the next few years. In the subway the current is supplied from an overhead wire because the extensions are to be built as street railways on the trolley system. The direct-current system is used with 1100 volts on the trolley wire. The length of the subway is 4 km (2.5 miles).—*Elek. Zeit.*, May 7, 1914.

Installations, Systems and Appliances

Electric Heating and Cooking.—J. W. HAME.—His presidential address before the "Point Fives" on various details of electric heating and cooking apparatus. As to the difference of opinion among users of cookers whether heating from the sides or heating from the top and bottom is preferable, the author has a personal leaning toward the latter method. He doubts whether it is a wise policy to increase the cost of electric cooking apparatus by the addition of glass windows in the doors and the supply of thermometers. The cookers should be provided with some much more prominent indicating device than the small opening of the switch with the "on" and "off." Illuminated glass disks

or other illuminating or conspicuous indicating devices to show what is being used are most necessary when using electric cookers. He mentions several British makes of heating and cooking apparatus which he has found particularly useful. As regards metallic utensils, in his experience the cast-iron kettles and pans with the bottoms turned or ground flat have proved the best, taking into consideration the cost of the utensils. In a test which he recently made as to the time taken to boil water, twice as much time was required to boil water in a utensil which had been in use on a coal fire as to boil a similar quantity of water in a cast-iron kettle with a ground bottom. The two utensils were heated on the same hot-plate, and both were started cold. When wiring houses it is desirable to include as much wiring as possible for wall sockets and plugs, and no opportunity should be missed in persuading new consumers to have a circuit run around the rooms which are most frequently used, the wires being run under or on the surface of the skirting board. There was a long and extended discussion. J. W. Beauchamp and W. G. Pickvance advocated the use of thermometers. P. Rycroft thought that the electric iron was the best introduction to other uses of electricity. W. Travis thought that it was a hardship that British electrical supply engineers must pay for their experience; he suggested a central association or bureau of research. W. S. Pickvance and S. T. Allen thought that it is most desirable for each central-station engineer to test personally various types of ovens under actual conditions. R. S. Downe said that the cooking business will be greater than the motor-service business. The possibilities are enormous because of the non-combustive action of electrical operations. F. Farndon approved of the system recently adopted by Seabrook, that is, in making a nominal charge for hire and slightly increasing the charge for energy, with a view to bringing the total hire to a figure approximating the present standard rental. The additional price per kw-hr. would, however, appear to be an arbitrary figure, depending entirely on the class of district and individual consumption. A. H. Seabrook remarked, in connection with the position of the heating elements, that he saw no reason why side heating should not be standardized. Cast-iron pots with turned bottoms proved the best for hot-plate heating. He emphasized the necessity of fixing to each cooker either a rapid boiler or a separately heated kettle for small quantities of water required quickly. Either of these heaters would supply hot water at a quicker rate than is obtainable by gas.—London *Electrician*, May 8, 1914.

Electrochemistry and Batteries

Electrically Melted Ferromanganese.—An article giving the results from practice in three European steel plants where a molten supply of ferromanganese is kept at hand at the converter plant, the ferromanganese being molten in an electric furnace. The first plant to take up this practice in this country has been the Illinois Steel Company, which at its converter plant at Joliet, Ill., employs a 4-ton Héroult furnace to keep on hand a supply of molten ferromanganese from which 150 lb. is taken every seven minutes. The three European plants from which figures are given in this article employ induction furnaces for melting the ferromanganese, and from the results obtained an estimate of the energy requirements and savings to be expected in new installations is made. It is stated to be safe to figure on a saving of 30 per cent in weight of ferromanganese and an energy consumption of 675 kw-hr. per metric ton of ferromanganese for a 3-ton furnace in regular operation. Other metallurgical advantages of the use of molten ferromanganese resulting in a better quality of the steel are pointed out.—*Met. and Chem. Eng'ing*, May, 1914.

Units, Measurements and Instruments

Electrometer.—An illustrated description of a new electrometer devised by Szilard for the measurement of radio-activity, as shown in Figs. 5 and 6. The movable system of the electrometer is a fine stiff needle with a piece of wire bent into circular form *A*. This piece of wire *A* can move into the interior of the charged system *S*. A directing force is exerted upon the needle *A* by means of the spiral spring *R*, the tension of which may be adjusted by means of the screw *V*. The system *S*, which is electrically charged, consists of two segments arranged parallel, one above the other, as shown in Fig. 6, this being charged through the rod *G*. The influence effect of the segments *S* upon the circular bent wire *A* at the end of the needle produces the deflection of the needle. Since the needle is not charged the scale may be placed directly below it. The sensitiveness is about 5 volts per degree of the dial.

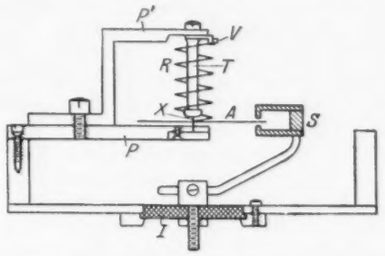


FIG. 5—SECTIONAL VIEW OF ELECTROMETER

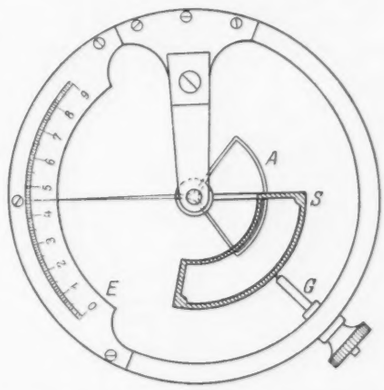


FIG. 6—TOP VIEW OF ELECTROMETER

If the electrometer is equipped with a micrometer, it is easy to estimate the one-hundredth of a degree, that is, 0.05 volts. The mean capacity of the apparatus is 2.5 electrostatic units.—*Elek. Zeit.*, May 7, 1914.

Telegraphy, Telephony and Signals

Telephone Cable.—W. J. HILLYER.—An article on the new London-Birmingham-Liverpool telephone cable. The route length between London and Birmingham is 110 miles, and that between Birmingham and Liverpool is 90 miles. Stoneware multi-way ducts of 3⅜ in. internal diameter are being used to form the conduits. The air-space paper-core cable contains two 300-lb., fourteen 200-lb., twelve 150-lb. and twenty-four 100-lb. loops made up in multiple twin four-wire core formation. All the loops will be loaded at the outset, as will also twelve superposed circuits formed. Tables are given for the electrical constants of the line itself and of the loading coils. The loading spaces are 2½ miles.—

From *Post Office Elec. Eng. Jour.;* abstracted in London *Electrician,* April 24, 1914.

Automatic Switchboard Telephone Systems.—W. LEE CAMPBELL.—The paper describes a telephone-traffic recording machine by means of which not only the number of calls for a given period, but also the average duration of each call, is mechanically registered on a moving tape. The observations recorded here were taken on an automatic telephone system. The graphical record shows the exact duration of each connection, the number of connections made during a given interval, and the number of simultaneous connections in service at each instant. By means of these records it is possible to study the relative efficiency of small and large junction groups and the average time of calls, and these observations permit the switches and junctions to be so arranged that the calls will be evenly distributed among the junctions in each group.—London *Electrician,* April 24, 1914.

Wireless Telegraphy.—H. PARODI.—A mathematical article on Eccles' theory of wireless telegraphy. The passage of an electromagnetic wave through an ionized atmosphere results in an increase in the speed of propagation. In an atmosphere in which the ionization is distributed the electromagnetic rays are refracted and the degree of refraction is the greater the smaller the frequency of the vibration. From this fundamental fact Eccles draws important conclusions on the effect of the frequency in wireless telegraphy transmission.—*La Lumière Elec.,* April 11 and 18, 1914.

Miscellaneous

Kinematograph Projector.—One of the great objections to the use of the kinematograph for educational purposes has been the inability of the lecturer to stop the film at any particular place in order to point out to his class any special features or printed matter, etc., on the film. With the ordinary type of projector this proceeding would cause the film to catch fire, or the gelatine to melt in the case of a non-inflammable film. The heat from the lantern is easily sufficient to bring this about if the film is stopped in the gate for more than the fraction of a second necessary to project the picture under normal conditions. By means of Kamm's kinematograph projector, a demonstration of which was given at the Regent Street Polytechnic, London, recently, it is claimed that any particular picture can be projected as a lantern slide at the will of the lecturer. This result is attained by means of a special form of shutter, situated behind and in close proximity to the film, and a special driving mechanism for the film. The shutter is formed of two or more fan-shaped sectors, which, when revolving at high speed, cause a powerful cooling draft to blow continuously on the film; also, as the shutter is placed between the film and the lantern, it intercepts directly a large amount of heat which, in the ordinary type of projector, with the shutter in front, falls directly onto the gate. A clutch operates the feeding mechanism of the film, and when it is desired to stop the film the clutch can be thrown out and the film comes to rest. This clutch may be operated from a distance by means of an electromagnet. To start the film again it is necessary only to throw in the clutch, but it is desirable to start the film by hand in order to save the wear on the clutch as far as possible.—London *Electrician,* April 10, 1914.

Patents.—C. L. CLARKE.—The first part of a serial on patents from the standpoint of the technical and practical man in the field of engineering.—*Gen. Elec. Rev.,* May, 1914.

Protection Against Lightning.—The rules of the German Association of Electrical Engineers on the erection of lightning rods have been supplemented by four appendices dealing with the protection of factory smokestacks, churches, windmills and reinforced-concrete structures.—*Elek. Zeit.,* April 30, 1914.

German Association of Electrical Engineers.—The twenty-second annual meeting is to be held from May 24 to May 28 in Magdeburg.—*Elek. Zeit.,* April 30, 1914.

Book Reviews

ALLGEMEINE ELEKTROTECHNIK HOCHSCHUL-VORLESUNGEN. By P. Janet. Vol. I. Leipzig, Germany: B. G. Teubner. Paper, 280 pages, illus. Price, 7 marks.

This book is a German translation of Prof. Paul Janet's work. As a class book for students of elementary electricity, it seems interesting and suggestive. In reviewing a book of this character by a French author one cannot resist the temptation to indulge in a comparison with the master treatise of Mascart and Joubert, which is so well known and clear. It is rather difficult to do justice in a review to a book which has passed through a double translation. There can be no question that the book will be of great interest to German readers, but it can hardly be expected that the American reader will take the trouble to study the German translation while the French original is accessible.

HALSEY'S HANDBOOK FOR MACHINE DESIGNERS AND DRAFTSMEN. By F. A. Halsey. New York: McGraw-Hill Book Company, Inc. 500 pages, 700 illus. Price, $5.

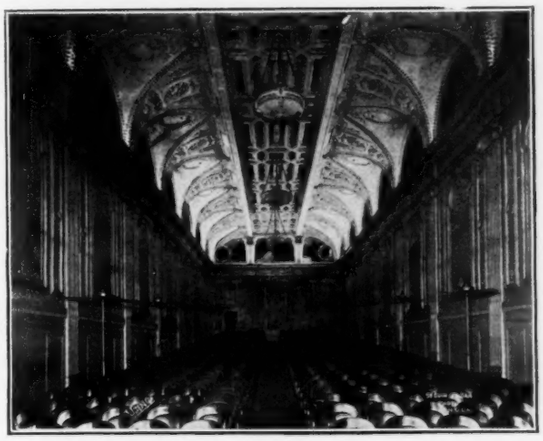
This volume marks a departure from conventional methods adopted in the preparation or compilation of what is usually referred to as a handbook. The dimensions of the book are such as to remove it utterly from the class of more or less bulky publications commonly referred to as pocket-books. It is essentially a book for the office desk, but the title "handbook" correctly indicates the nature of its contents. Admitting that the book is not of a conveniently portable size, the advantages of the large page are many and obvious, the chief of these being the possibility of presenting diagrams or charts on a large scale, thus greatly enhancing their value. A great deal of the material has been gathered from the pages of the *American Machinist,* but care has been exercised in the selection of the articles worthy of a permanent place in this compilation. All such information as one expects to find in a reference book on machine design is to be found within the covers of this book, and in addition there are sections on hydraulics, steam boilers, the steam engine, and compressed air, which are here mentioned to indicate the comprehensive nature of Mr. Halsey's work. An important and commendable feature of the book is the completeness of the section containing mathematical tables. This includes all that the designer or mechanical engineer is likely to require. It contains tables of hyperbolic functions in addition to common logarithms and anti-logarithms. Although the repetition of such tables in the various handbooks or "pocket-books" may seem to involve much unnecessary work, yet no reference book for the use of engineers, whether designers or draftsmen, can be considered complete without them. The design and arrangement of the book are such that it can be kept continuously "up to date" by the dropping of old matter and the introduction of new material as subsequent editions may be called for. Both author and publisher are to be congratulated on the excellence of this exceptional work.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Indirect Lighting for New Orleans Theater

The system of lighting in the Trianon Theater, New Orleans, La., has recently been changed from direct to indirect. The lamps are in Frink reflectors placed

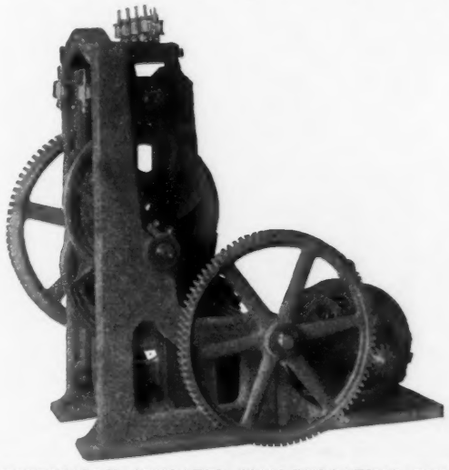


INDIRECT-LIGHTING UNITS IN NEW ORLEANS THEATER

in the coves behind the cornice. Tubular lamps of the linolite type, measuring about 1 ft. in length and 1 in. in diameter, are used. This indirect-lighting installation was made by the New Orleans branch of the H. W. Johns-Manville Company.

Non-Pulsating Pump

The pistons of the pump shown in the accompanying illustration are not operated from a crank shaft as in the ordinary type of reciprocating pump but by cams.



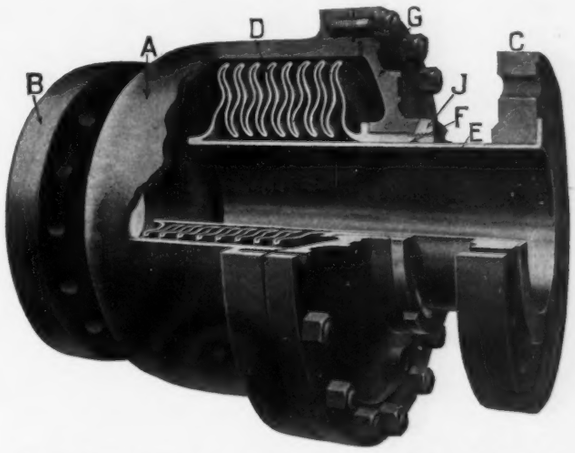
ELECTRICALLY OPERATED NON-PULSATING PUMP

The cams are keyed to the main shaft, and each transmits its motion to its piston by means of a sliding yoke, rollers being used to minimize friction between the cam and the yoke. The manufacturers claim that this construction keeps the load on the piston more uniform than that where the piston passes through a cycle and runs from full load to a complete stop and back again as in the crank-shaft pump. Hence there is said to be no pulsation, and there is less strain on the pump; high efficiency, therefore, results, owing to the absence of backlash when gears and other parts of the pump have become worn.

The manufacturers guarantee an efficiency of 80 per cent for the pump. The Liutweiler Pumping Engine Company, Cleveland, Ohio, manufactures this pump, and electric motors made by the Westinghouse Electric & Manufacturing Company are used for the drive.

High-Pressure Steel Expansion Joint

The high-pressure steel expansion joint illustrated herewith is being placed on the market by the Alberger Pump & Condenser Company, New York. In this ex-



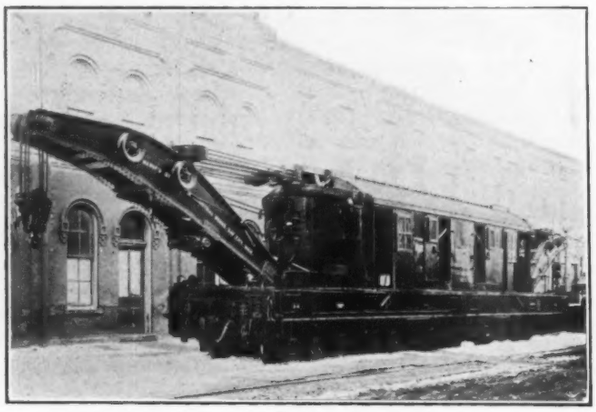
STEEL EXPANSION JOINT FOR HIGH-PRESSURE SERVICE

pansion joint use is made of a nest of circular disks stamped from steel plates with a high elastic limit welded together to form a flexible bellows, which absorbs the movement of the pipe line.

As shown in the illustration, one end of the nest is welded to the steel tube *E* and the other end to the steel sleeve *F*, the latter being held in place by the locknut *J*. Leakage between the sleeve *F* and the casing head *G* and the casing *A* is prevented by special gaskets. Only the outside of the bellows is under steam pressure, and therefore no condensation can collect within the disks themselves. The working portion of the joint is protected from outside injury by the cast-iron casing *A* and the casing head *G*, which are designed to withstand pressures up to 200 lb. per square inch. To safeguard the expansion joint against excessive movement, the flange *C* will strike the locknut *J* when the maximum lineal movement for which the joint is designed is employed.

100-Ton Tunnel Crane Operating on Storage-Battery or Third-Rail Energy

A double-end electric wrecking car with two independent 100-ton cranes at each end has been constructed recently for operation in the Grand Central Terminal yard, New York. While being adapted to use on



CRANE MECHANISM FOR ELECTRIC WRECKER

the main line of the electrical division of the New York Central Railroad, it is specially designed for underground clearances existing in tunnels. The equipment possesses the functions of a crane with many of those of a high-powered electric locomotive.

Storage-battery energy may be used for intermittent and emergency service, when the third rail is deenergized or when cable connections cannot be made with a feeder line. The battery, which consists of 230 cells, has a rating of 75 amp for eight hours, with maximum discharge rate of 350 amp for two hours. A complete testing and charging outfit is installed in order that the battery may be charged wherever a connection can be made with a feeder circuit.

The electrical equipment is noteworthy, not only on account of the power it develops, but because of its flexibility of operation. Six motors with a total rating of 1100 hp operate the equipment, four motors rated at 200 hp each being used for propelling, and two of 150 hp each for hoisting and operating the crane machinery. The propelling motors are directly connected to the axles of the compound trucks, two at each end of the car. They are arranged so that all four or only the two at each end may be operated simultaneously. They are capable of operating satisfactorily on voltages between 300 volts and 750 volts.

During a trial test conducted by the railroad company the crane propelled itself at a rate of 34 miles an hour while hauling an 80-ton rolling load. Satisfactory operation is also possible by using only the two motors at each end of the car, the resulting speeds being about 60 per cent of those obtained when four motors are used.

Standing on a solid foundation and braced with outriggers, the wrecker is capable of lifting the following loads: 100 tons at 24 ft. 2 in. radius straight ahead or 6 ft. 6 in. either side of the center; 100 tons at 22 ft. radius straight ahead or 12 ft. either side of the center, and 100 tons at 13 ft. 8 in. swinging through 180 deg. Without using outriggers the following loads can be hoisted: 50 tons at 24 ft. 2 in. straight ahead and 25 tons at 13 ft. 8 in. swinging through 180 deg.

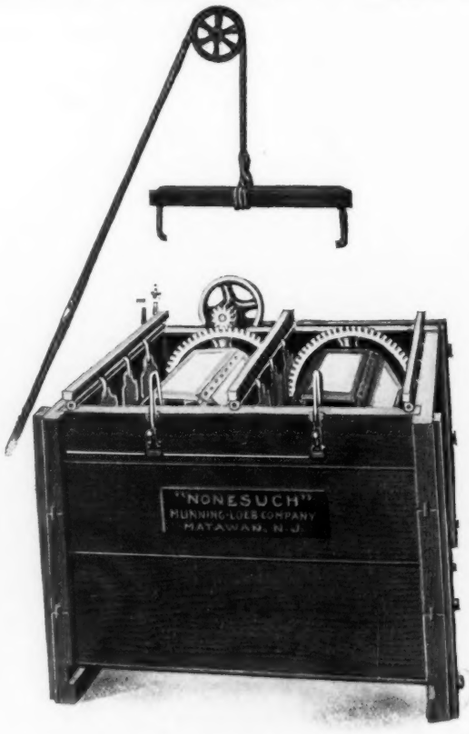
The wrecking car was designed and built by the Industrial Works, Bay City, Mich., from specifications prepared by a committee consisting of Messrs. H. A. Currie, assistant electrical engineer; B. J. Buell, wrecking master, and C. H. Quereau, superintendent electrical construction, New York Central & Hudson River Railroad.

Electroplating Machine

A machine for electroplating small articles in quantities with nickel, brass, copper, zinc, etc., has been designed and is being placed on the market by the Munning-Loeb Company, Matawan, N. J. With this apparatus the work is subjected to a tumbling action, and by the time the deposit reaches the desired thickness it is said to receive a good polish.

The tank is made of 2-in. clear cypress, which is painted both on the inside and outside with a special paint impervious to the action of ordinary solutions. The tank is also lined with a semi-flexible composition. The material to be electroplated is placed in a compartment consisting of two strong hexagonal end pieces of mahogany connected by mahogany staves. Five of the sides of the octahedron thus formed are covered by removable canvas panels the edges of which are corded so that they can easily be slipped in and out of the grooves in the staves, and the sixth is closed by a perforated mahogany cover. It is through the latter opening that the pieces to be plated are passed within. The plating compartment is rotated by a gear wheel meshing with a pinion attached to the pulley shaft. These gears are not in the electrical circuit, and therefore no deposit can take place on them.

The cathode connection consists of a copper busbar



DOUBLE-COMPARTMENT ELECTROPLATING MACHINE

attached to a conductor which passes over the edge of the tank and terminates in a bearing which conveys the energy through a copper journal to a swinging chain or rod embedded in the work. This rod does not revolve with the barrel, but remains in contact with the work and falls continually to the bottom of the cylinder with the articles and does not interfere with their rolling.

The anode connections are heavy copper or brass tubes upon which the anodes are hung. These run along the upper edge of each side of the tank on a single-compartment machine. In a double-compartment machine, shown herewith, an additional or third rod is provided, running across the center of the tank upon which the flat anodes are hung with hooks. These rods are covered by wooden strips which serve the double purpose of keeping the anode rods clean and acting as supports for the draining tray. In the single-compartment machine six curved anodes are used, three being placed on each side of the compartment and curving around underneath it. In the double-compartment machine six curved and three straight anodes are employed, the latter being hung between the two compartments.

Alligator-Jaw Testing Clamp

In the operation of a large central station the cost of testing the customers' watt-hour meters is an item of considerable expense. This is especially the case in connection with large installations where the meters must be tested without interrupting the service and where the current must be shunted from the meter. Of the many protective devices now being utilized for testing and shunting meters without danger of interrupting the service or injuring the employees, the testing clamp shown herewith will meet the requirements of any installation, the manufacturers claim, and reduce the time of shunting to a minimum.

The clamp is made on the alligator-jaw principle and is operated from the front, thereby making the possibility of a short-circuit small. It is rugged in construction, being made entirely of brass and bronze. Although weighing only 0.5 lb., the device can grip a cable or flat bar up to 1.125 in. thick, and when provided with proper conductors can carry 600 amp. The clamp can be put in place by hand, no wrench or screwdriver being necessary, and it is so designed as not to scratch or mar the switch blade or bus. It can be removed easily from the flexible conductor, and it is well adapted for use in motor tests or for making any temporary connection in construction work. This clamp is being placed on the market by the Albert & J. M. Anderson Manufacturing Company, Boston, Mass.

ALLIGATOR-JAW TESTING CLAMP

Radiotelephony for Railroads

On account of the success that attended the wireless-telegraph installations on the Delaware, Lackawanna & Western Railroad during the nine-day paralysis of its wires in last February's blizzard the officials of that system have been investigating the possibilities of the radiotelegraph and radiotelephone on their moving trains.

Wireless-telephone apparatus was recently installed at Scranton, Pa., and on one of the through fast trains. The Scranton installation, though hurriedly made, was able on its second trial to maintain clear voice transmission to this train as far as to Stroudsburg, Pa., a distance of 53 miles, the train running at 60 miles per hour. The antenna at Scranton is 300 ft. long and 150 ft. high; that on the train extends over the four forward cars only, the station being in the second car from the locomotive. On account of train noises it is necessary to use an amplifier and a detector. A two-step amplifier, giving from fifty to sixty times amplification, is used on the train. The generator is directly connected to a steam turbine in the baggage coach, which is supplied with steam from the steam-heating pipes beneath the car. At the Scranton station 125-volt direct current is used.

The present apparatus is of only 1-kw rating, but no difficulty has been had in telephoning from Scranton to Binghamton, a distance of 67 miles, over rough wooded and mountainous country. The officials of the Delaware, Lackawanna & Western Railroad purpose to make permanent installations on two of their fast-train equipments for facilitating dispatcher's service and especially for the convenience of the public.

RADIOTELEPHONY APPARATUS

In the radiotelephone equipment described a De Forest transmitter, an Audion amplifier and an Audion detector were used. These devices were built by the Radio Telephone & Telegraph Company, 309 Broadway, New York, which also made the installation at Scranton and on the Delaware, Lackawanna & Western train described above.

Electric Cooking Utensils

An electric tureen, illustrated in Fig. 1, is offered for sale by the Simplex Electric Heating Company, Cambridge, Mass. The device is made in either nickel-plated or copper finish. Its capacity is four pints. It

ELECTRIC EGG BOILER ELECTRIC TUREEN

is well adapted to the heating of canned soups and other prepared foodstuffs. This tureen is equipped with a quick-detachable connector. A 6-ft. silk cord with lamp socket attachment is also provided.

The electric egg boiler shown in Fig. 2 is a compact device that will boil from one to six eggs conveniently held in a removable rack. The boiler is so constructed that eggs can be prepared in various forms; it can also be utilized as a small tureen if desired. This utensil is double-tin-lined and can be easily kept clean.

Oil-Fuse Cutouts

Oil-fuse cutouts for high-tension work have been designed by the D & W Fuse Company, Providence, R. I. In these cutouts the fusible element is placed under a heavy body of special oil. The terminals are so arranged that on the blowing of the fuse they are forcibly thrown apart and the oil is interposed between them, thus preventing the formation of an arc. The cutout is provided with a venting system which avoids the accumulation of pressure within the casing and also the blowing out of any considerable quantity of oil. The oil container is equipped with a plug outlet at the bottom which permits the drawing off the oil when

OIL-FUSE CUTOUT

necessary. The cutouts are provided with flexible cable terminals to which the line terminals can be soldered. The fuse links are made of an alloy of low melting point and high conductivity. These cutouts are made in three sizes, rated at 50 amp, 100 amp and 200 amp respectively.

Electric Vehicle Call

A vehicle-call system operated from a special form of pedestal switchboard rather than from the usual panel in the wall has recently been installed in the department store of James McCreery & Company, New

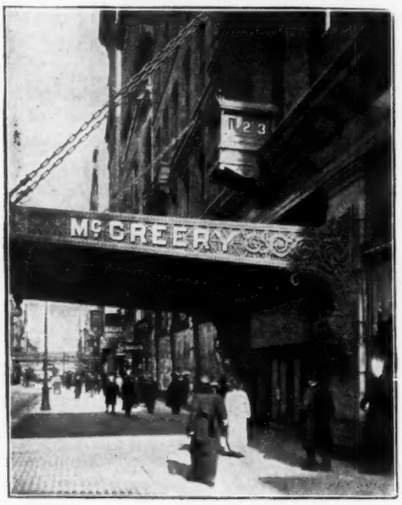


FIG. 1—ANNUNCIATOR OUTSIDE OF NEW YORK DEPARTMENT STORE

York. The pedestal switchboard is in the center of the lobby, where it is in plain view of patrons of the department store.

The method of operating the switchboard, which was designed by the Western Electric Company, New York, is simple. When shoppers arrive at the store they receive a numbered check from the carriage man stationed at the curb. This check is kept in the possession of the customer so long as he or she remains in the store. When the patron is about to leave, the check is handed to the operator, who moves the switch levers

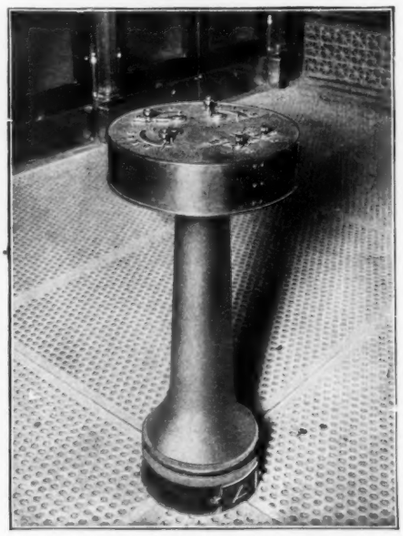


FIG. 2—PEDESTAL SWITCHBOARD

on the dial face of the pedestal to numbers corresponding to those on the check. The numbers are reproduced on both sides of the vehicle-call annunciator on the outside of the building. For night service a lever switch is provided on the switchboard for lighting a bank of lamps which illuminate the numbers.

Street Hoods for Nitrogen-Filled Tungsten Lamp

The street hoods illustrated herewith are designed for use with the new nitrogen-filled tungsten lamps as well as the old types of incandescent lamps. In Fig. 1 is shown a one-piece fluted street hood, the body of which consists of an iron canopy and a porcelain housing with clips for holding the 20-in. reflector. The canopy is ventilated by means of arches around the lower edge. These arches do not allow moisture to penetrate inside the housing; cool air, however, can circulate through the porcelain body, thus preventing the overheating of the metal parts of the socket as well as the neck of the lamp. In Fig. 2 is shown a one-piece fluted street-hood body with a 24-in. reflector designed for large-sized lamps. The outer glove has a 1.5-in. hole in the bottom.

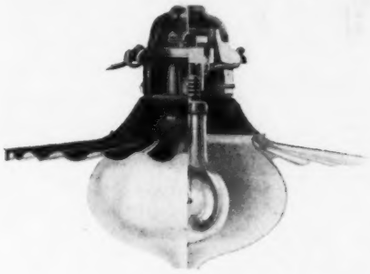


FIG. 1—ONE-PIECE FLUTED STREET HOOD BODY WITH 24-IN. REFLECTOR

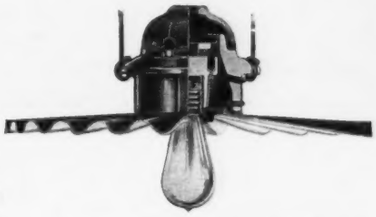
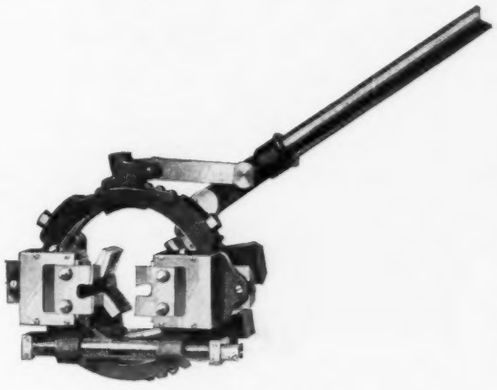


FIG. 2—ONE-PIECE FLUTED STREET HOOD BODY WITH 20-IN. REFLECTOR

These tungsten-lamp fixtures are being placed on the market by the George Cutter Company, South Bend, Ind.

Pipe Cutter

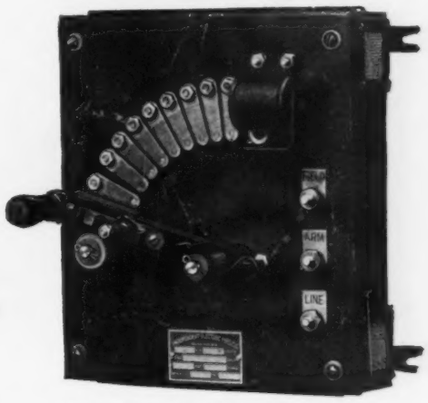
A 2.5-in. to 4-in. pipe cutter designed to cut pipe square without any burrs is being placed on the market by the Borden Company, Warren, Ohio. This cutter is provided with an automatic feed. Use is made of a peculiarly shaped knife with which the cut is so regulated that a very thin section of the pipe is cut out. The pipe is accordingly not depressed and the end of the pipe is left clean and square without any burrs. The manufacturers claim that this cutter will not split the pipe and that it is easy to start a threading die after cutting the pipe with this tool. This pipe cutter, which is illustrated herewith, is operated by a ratchet and can be used in any position. It is a development of smaller cutters which have been put out by the same company.



PIPE CUTTER

Casing for Starting Rheostats

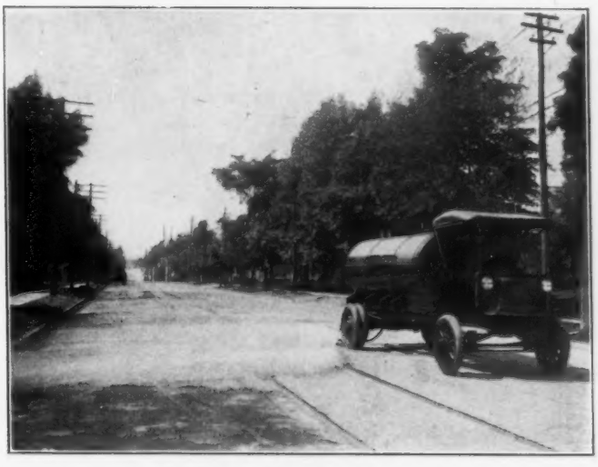
The Independent Electric Manufacturing Company of Milwaukee, Wis., is placing on the market a casing for starting rheostats and controllers. The casing in which the resistor units are mounted is of cast iron, and in the sides of the box, at the top and the bottom, are four large ventilating openings. These openings are covered with heavy non-corroding screens of fine mesh which allow free passage of air into the box and which are said to prevent any sparks or flames emanating from the box in case of a burn-out of the units. The principle on which this prevention is based is the same as that with safety lamps. There are no external openings in the bottom plate of the box, so that should a burn-out occur the molten parts dropping to the bottom of the box cannot fall to the floor. This box has been approved by the Underwriters' Laboratories.



CAST-IRON CASING FOR STARTING RHEOSTAT

Electric Sprinkler Truck

A 5-ton electric sprinkler truck with a 1200-gal. tank is shown in the accompanying illustration. The tank is 160 in. long and has an inside diameter of 51 in. An air compartment is provided in the forward end of the truck. This compartment is 36 in. long and its volume is 25 per cent that of the tank. The holding capacity of the air tank is 65 lb. The total weight of the tank is 3600 lb. The tank is equipped with air-pressure and



ELECTRIC SPRINKLER TRUCK

water-pressure gages and a pop safety valve is provided in the by-pass connecting the water space with the air chamber. The water discharge is controlled through lever gate valves which are operated by hand levers at the driver's seat. The two flusher nozzles can be worked together or independently of each other. The tank is mounted on five 4-in. oak benches. The battery box is under the seat as shown. This electric sprinkler is being made by the General Motors Truck Company, Pontiac, Mich.

Reverse-Power Relay

A reverse-power relay for direct-current circuits designed primarily for use with shunt trip circuit-breakers is being manufactured by the Roller-Smith Company, 203 Broadway, New York. The instrument is equipped with a platinum contact attached to the instrument needle, which contact co-operates with a similar contact carried by an adjustable pilot needle. The pilot needle can be set at any point between zero and full load. The circuit established on engagement

REVERSE-POWER RELAY

of the contacts energizes an electromagnet contained in a rectangular casing below the instrument and mounted on the same slate base as shown in the accompanying illustration. The electromagnet establishes whatever external circuit closure the relay is to effect. Being of the separate shunt type, the dimensions of this relay are independent of the volume of current or size of the breaker to be controlled. The relay can be mounted on the board or as far away as desired, only four small wires being used for the connections.

Series-Multiple Transformer for Street Lighting and Farm Service

A transformer designed to operate with its primary coil connected in series with high-voltage series circuits and its secondary winding available for constant current at low voltage has been brought out by the Kuhlman Electric Company, Elkhart, Ind. For applying this transformer to a 7000-volt, 7.5-amp series-lighting circuit the secondary has been designed so that a high-efficiency gas-filled tungsten lamp may be operated from it satisfactorily. The manufacturer states that the insulation resistance between the primary and secondary windings is designed to withstand 30,000 volts. Since the interruption of local lamp circuits does not interfere with the primary series circuit the greater reliability of this system is pointed out. Transformers of this type which have been in operation in Chicago parks for some time are said to operate with current variation not exceeding approximately 3 per cent.

In designing these transformers for farm service the company has taken into consideration the fact that line construction for this type of service must be inexpensive, and the use of a series-multiple transformer allows a single line wire to replace the pair of wires necessary where multiple transformers are employed.

Metallized Graphite

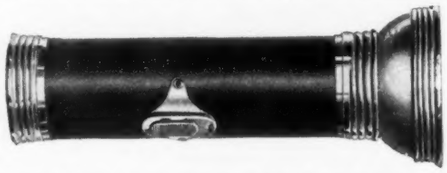
Metallized graphite, known as "graphalloy," is a product consisting of graphite impregnated with molten metal. In the manufacture of this material the molten metal is forced into the pores of graphite blocks or rods by means of high air pressures. The material is utilized quite extensively for bearings on light-duty machinery operating at high speeds, such as loose pulleys, fans, small motors, trolley-wheel bushings, etc. It is also employed for other classes of service such as in bushings for escalators, bushings for tackle blocks, bearings for windmills, etc.

The basic element of graphalloy is pure graphite, which is said to be the most efficient solid lubricant known. The object of the metallic impregnation is to solidify the product so that it can be machined into bearings or bushings of any desired form which will have requisite strength and durability. Different metals and alloys are used for combining with the graphite according to the class of service needed. For example, with trolley-wheel bushings bronze is used; with packing rings for steam turbines, which are required to withstand high temperatures of live steam, copper or bronze is employed, and for electrical purposes, such as brushes for slip-ring alternators, motors, rotary convertors, low-voltage direct-current generators, etc., use is made of copper or copper alloys. This graphalloy is said to have a high compressive strength and can be machined to accurate dimensions. The material can also be tapped and threaded.

The Graphite Metallizing Corporation, Yonkers, N. Y., is placing this material on the market.

Contact for Flash-Lamp Case

An improved contact for its flash-lamp cases has been developed by the Beacon Miniature Electric Company, 110B Duane St., New York. This contact consists of a double locking device. In opening the circuit, the outer slide moving along the plate is locked on the plate and



FLASHING-LAMP CASE WITH DOUBLE-LOCKING CONTACT

a pressure of the finger is required to move it out of place. In closing the circuit the slide is moved along the plate in the opposite direction to a point where it is locked, pressure being necessary to move it out of place. This contact, it is said, eliminates the possibility of accidentally closing the circuit on placing the flash-lamp in one's pocket.

Large High-Voltage Testing Transformers

Two testing transformers are shown in the accompanying illustration, with a normal rating of 360,000 volts for continuous service and 500,000 volts for short periods. These transformers were recently furnished to the Inawashiro Hydroelectric Power Company of

360,000-VOLT TESTING TRANSFORMERS

Japan. One unit is to be installed in the generating station on the Nippashi River at the outlet of Lake Inawashiro, about 145 miles from Tokio, and the other in the receiving substation at Tokio. They will be used for testing transmission lines and apparatus in these stations.

The features of interest in the design of these transformers are the arrangement of the windings to give distributed static fields, the use of condenser terminals to give distributed stresses from terminals to ground, and the terminal "hat" to distribute stresses from the terminal tip to ground. The transformers are 19 ft. high from the base to the top of the terminal, and the tanks are 9 ft. high and 9 ft. in diameter. One high-tension terminal of each transformer is grounded to the core and case, the other being brought out as shown in the illustration. By connecting the cases of the two transformers, 1,000,000 volts can be developed between the two high-tension terminals.

These transformers are similar in construction to the 500,000-volt testing transformer described in the *Electrical World* of March 16, 1912. They were built by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Shipping Box for Non-Metallic Flexible Conduit

A corrugated box has been designed by the Tubular Woven Fabric Company, Pawtucket, R. I., for shipping its non-metallic flexible conduit known as "duraduct." Heretofore this conduit has been shipped in loose coils. With a shipping case the material is handled safely and can be rehandled, the manufacturers declare, with a minimum of expense. The package also permits the advantageous stocking of the conduit, and each container can be marked so that the contents may be ascertained at a glance.

Three-Oven Range

A three-oven electric range designed to serve the needs of twenty people is shown in the illustration herewith. It is constructed of sheet metal and aluminum, no castings being used. The ovens are heavily insulated and are said to retain practically all the heat generated. The only wires entering the stove are the feed wires for the ovens. All wiring is contained in a metal box underneath the hood. An automatic thermostat, controlling each heating element and adjustable at will for any degree of heat required, is placed beneath the hood. The adjustment of this thermostat is made by a knob and pointer which are attached to a dial.

When the desired temperature is reached the thermostat automatically cuts off the energy supply, and then as the oven gradually cools the heating unit is automatically put in circuit again and the oven is brought back to the predetermined temperature.

The stove is 64 in. high, 51 in. wide and 25 in. deep. The two outside ovens are equipped with one heating unit each. The middle oven is provided with a unit in the bottom and one in the top for broiling, toasting, etc. The two outside ovens are 11.5 in. by 11.5 in. by 18 in. The middle oven is 12.5 in. by 13.625 in. by 21 in. Each heater is connected with a pilot lamp. Three receptacles are provided for surface cooking or the attaching of any electrical appliance. Condensation is

THREE-OVEN ELECTRIC RANGE WHICH WILL COOK FOR TWENTY PEOPLE

carried to a drip pan by means of troughs and pipes. The stove is equipped with a porcelain-lined broiler pan and five wire grates. It is enameled in gray with nickel trimmings.

The Olston Electric Stove Company, Los Angeles, Cal., is placing the range described in the above paragraphs on the market.

Jobber, Dealer and Contractor

Buying Advertising Space from Contractors

In perhaps no other city are the relations of the contractor and the central station more amicable than those existing in Cleveland, and the reason for the real co-operative efforts being put forth in that Ohio city may perhaps be found in the fact that both the contractors and central stations are doing just a little more than their share to make each endeavor a success. In advertising electric service the Cleveland Electric Illuminating Company has recently begun to purchase a portion of the contractors' windows, paying for the space according to its advertising value. The illuminating company places electrically lighted advertising transparencies in the windows, allowing the contractor to display whatever electrical apparatus he chooses. Energy for illuminating the transparent sign is supplied from a separate circuit and is paid for by the illuminating company.

New Building of the Northwestern Electric Equipment Company

By alertness and progressive methods the Northwestern Electric Equipment Company, of St. Paul, Minn., has been able to build up a business now typified by a new building which is a credit to the electrical interests of that city. The structure is seven stories high and is at 174-178 East Sixth Street, in the center of the wholesale district. The building is of reinforced-concrete construction and provides for 60,000 sq. ft. of floor space. The accompanying illustrations show various interior views. Office illumination is accomplished by means of indirect lighting, while direct illumination is used in the remainer of the building. All the interiors in the entire building received two coats of white paint to give maximum light reflection. Three electric elevators are used, energy being obtained for all requirements from the central-station mains.

The demonstrating rooms are found on the first floor, and here are shown electrical appliances in large variety, the devices sold being both for industrial and domestic requirements. The building is one of the largest in the Mississippi Valley devoted to the exclusive needs of an electrical jobbing house. It is equipped with modern facilities for carrying on the work of the company and the other activities of the concern.

FIG. 1—CITY SALES DEPARTMENT

Established by Mr. Frank B. Thompson, the president of the company, in 1900, as the Thompson Electric Company (the name being changed in 1903), the Northwestern Electric Equipment Company has come into prominence for its up-to-date merchandising methods in handling electrical supplies of all kinds. The business of 1913 was nearly $1,250,000. The officers of the company have managed not only to make a success of their business but to accumulate a large stock of personal popularity. In addition to President Thompson, they include Vice-president James M. Whalen, Secretary and Manager Albert J. Anderson and Manager of Sales J. M. Hannaford, Jr.

FIG. 2—A CORNER OF THE PANELBOARD SHOP

FIG. 3—VIEW OF THE STOCKROOM

FIG. 4—WIRING DEVICES IN STOCK

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Chicago Railway Exhibit.—The Permanent Railway Supply Exhibit, of Chicago, which until recently was housed at 900 South Michigan Avenue, has been removed to 14 East Jackson Boulevard.

Spring Works Keeping Busy.—The business of the Cary Spring Works, 240 West Twenty-ninth Street, New York, is good. A large amount of the work being done by this company is for the Western Electric Company for use on telephones.

Business in Automobile Accessories Good.—In spite of the recent slump in the automobile business, the Roller-Smith Company, 203 Broadway, New York, manufacturer of electric accessories for automobiles, is finding business good. One reason for this, it is declared, is the increasing number of gasoline cars using electric starters and electric lighting systems.

More Capital for Electric Stove Company.—The capitalization of the Copeman Electric Stove Company, Flint, Mich., has been increased. For the past year this company has been rather inactive, pending the development of its new all-steel ranges, which supplant its old wooden automatic stoves. The company is now in the field for new business with new designs of ranges and accessories.

Orders from Foreign Countries for Transmission-Line Accessories.—The Clark Electric & Manufacturing Company, 149 Broadway, New York, has received orders from Australia, Japan, Spain and South America for its insulator clamps and its seamless splicing sleeves. The latter is used to join two wires or cables. The joint is made by running two conductor ends into and through the oval sleeve and then with special tools twisting in opposite directions at each end of the sleeve. No solder is used.

Storage Battery Company Enlarges Its Service Depot.—The New York Service Depot of the Philadelphia Storage Battery Company has been removed to larger quarters. The plant now occupies the entire ground floor at 651-655 West Forty-third Street. Modern equipment has been installed. The plant is devoted exclusively to the construction, repair, recharging and sale of storage batteries and supplies. The depot is in charge of Mr. Walter L. Thompson, the New York sales agent of the company, with offices at 1789 Broadway.

Line Material Company Moves Into New Plant.—The Line Material Company, South Milwaukee, Wis., has moved into a new plant, which was made necessary on account of the growth of the business in the past few years. The floor area is about 35,000 sq. ft. and is occupied by the machine shop, forge, galvanizing plant, assembling shop, engineering department and office. The foundry is in the same building that was in use before the construction of the new plant. Two acres of land adjoining the company's old property has been purchased also to provide for possible extensions in the future.

Equipment for Power Stations.—The Empire District Electric Company, Joplin, Mo., has arranged to install in its Scammon, Weir City, Columbus and Kansas substations considerable new electrical apparatus, which comprises two 300-kw synchronous converters, one 210-kva frequency-changer set, three 500-kva water-cooled transformers, six 110-kva and three 75-kva transformers, switchboards and accessories. The Eastern Michigan Power Company, Jackson, Mich., recently ordered three additional 900-kva transformers. The Rogue River Public Service Corporation, Grant's Pass, Ore., has purchased a 750-kw alternating-current generator. The above equipment is to be furnished by the General Electric Company.

Montana Power in Anaconda Copper Company Mine.—In the annual report of the Anaconda Copper Mining Company for the year 1913 Mr. B. B. Thayer, the president, says that the service rendered by the Montana Power Company in furnishing electric power to the mines, reduction works and railroad was very satisfactory. While in most districts it would be somewhat hazardous, he said, to rely upon electric power alone without steam reserve plants for use in pumping and hoisting operations, the number of hydroelectric power plants and interlocking transmission lines established by the Montana Power Company make it practically safe in the Butte district, and in fact throughout the district which is served by that company.

Holtzer-Cabot Electric Company Starts Work on New Factory.—Construction was begun on May 21 upon a new five-story concrete factory building on Amory Street, Roxbury, Mass., by the Holtzer-Cabot Electric Company, of Brookline, Mass., manufacturer of electric motors, telephones, sundries and automobile accessories, the ground being broken by President C. W. Holtzer. The company is one of the oldest electrical manufacturers in the country, dating from 1875, when eight or ten employees were on the payroll. There are now over 800 employees, and the force will be increased when the new establishment is occupied about Jan. 1, 1915. The four existing plants of the company in Brookline and Boston will be united in the new building, which will easily house 1000 employees.

Small New York Contracting Firm Busy.—The New York Electric Installation Company, 43 West Twenty-seventh Street, New York, a firm capitalized at $10,000, is doing approximately 100 per cent more work this year than it did last year. Its business last year amounted to about $40,000. One of the installations this company is working upon is that for the Commercial Acetylene Company, Bound Brook, N. J. Sixty motors ranging from 2 hp to 50 hp in rating are being installed. The method of making this installation is interesting, no competitive bids having been sought by the acetylene company. The electric company is virtually an employee of the acetylene company and gets a commission for products bought and the labor necessary. In the purchase of equipment it advises where and how to buy.

Imitating Coal Fire by Means of Electricity.—An imitation coal fire is being manufactured by William H. Hoops & Company, 531 South Wabash Avenue, Chicago, Ill. The grate consists of an ordinary-sized coal-grate basket with a wire lining on which are placed ruby, amber and dark-ruby glass and sometimes a few pieces of genuine coal. Under the wire frame there is a system of wires and incandescent lamps. Sometimes a yellow light, sometimes a clear light and sometimes a red light is used. The effect when placed in the fireplace is said to be a very good imitation of a real coal fire. This company is also handling an "electric fire log" which is made abroad. The material used in the manufacture of this electric log is a secret combination of glass and other ingredients. It is used extensively in Europe and on ocean steamships. No heat comes from these logs, but when lighted they make a good imitation of real glowing logs.

Solderless Connectors for Substation Equipment.—In the new Jay Street substation of the Edison Electric Illuminating Company of Brooklyn, N. Y., solderless connectors manufactured by Dossert & Company, 242 West Forty-first Street, New York, are being used to a large extent. All leads, for instance, both top and bottom, to the disconnecting switches are connected by solderless plugs; all connections of primary and secondary leads and all delta connections to the transformers are with solderless lugs and cable taps; all connections from the switchboard to the copper, from the copper to the 1,000,000-circ. mil leads, and from the leads to the rotaries, are by solderless connectors,

and all leads to the switch studs of the "K" and "H-3" oil switches are connected by solderless stud connectors. Outgoing direct-current feeders, main high-tension bus, starting bus, outgoing neutral, etc., in this substation are also connected with solderless connectors.

Aluminum Business Improving.—The amount of business being done by the Aluminum Company of America is reported to be increasing. Aluminum conductors are being supplied to Western companies chiefly for extensions to existing transmission lines.

Electric Stove Company Increasing Capacity.—The Olston Electric Stove Company, Los Angeles, Cal., recently enlarged its plant. It is now turning out 650 ranges a month, which are made in three types. The three-oven range is the latest development. This stove, the manufacturers claim, has a capacity for serving twenty persons.

Iron Works Increase Property Holdings.—The Murray Iron Works Company of Burlington, Ia., has bought the property formerly occupied by the McCosh Iron & Steel Works. This property adjoins the Corliss engine works of this company and gives it about ten contiguous acres in the heart of the town. This is besides the foundry property in West Burlington.

Topeka Electrical Supply House Changes Ownership.—Messrs. H. S. Lee and C. W. Sears are the new owners of the Tucker Electric Company's stock and plant at Topeka, Kan., purchasing the establishment at a sale of receivers recently. The business will be continued by the new owners, the style being changed to indicate the transfer of ownership. Both men formerly were with the Eagle Electric Company, and both continued with the Tucker Electric Company when the latter took over the old concern.

Insulating Paints and Varnishes for Foreign Countries.—The Standard Paint Company, 100 William Street, New York, is said to be doing considerable business in Japan, Australia and South America. The business in this country is also good, that in the East, it is said, being somewhat better than that in the West. A cement-floor filler and cement-floor finish recently brought out by this company is reported to be meeting with considerable success. These compounds neutralize the free alkali, forming what is known as calcium resinate, which, it is said, not only seals up the alkali but results in a firmer bonding of the coating of paint to the cement surface. These cement-floor finishes are in demand for power houses and generating rooms, because the grit arising from unfinished cement-floor surfaces has a tendency to cause heating and sparking of the machinery and thus produce unnecessary wear on the moving parts.

Washing-Machine Selling Methods.—The Hurley Machine Company uses a method of selling its "Thor" washing machines which adapts itself very well to this industry. Letters are written to prospective customers explaining the advantages of the Thor washer and stating that in the course of a few days a representative of the company will call them up over the telephone. If the "prospect" appears interested, a salesman is sent to see him and describe more fully what has been told by letter and telephone. The results of this selling method are said to be neither sudden nor spasmodic, but a steady sowing of the seeds of suggestion finally brings many sales. Liberal terms are allowed on all machines. A fifteen-day trial free of charge is given to any one who can give satisfactory references. Mr. J. H. Clingenpeel, of the New York office, states that approximately 90 per cent of the machines delivered thus on trial are finally sold. Of interest in connection with the Hurley company's selling campaign is the fact that none of its salesmen is paid on a commission basis; they are all salaried men. Demonstrations are continually being made in all the branch stores of this company.

Sales Contest of Hobart Manufacturing Company.—During March and April the Hobart Manufacturing Company, Troy, Ohio, inaugurated a selling contest among its salesmen, of whom there are about a hundred in different sections of the country. A prize of $100 was offered to the salesman having the largest number of sales, $75 to the man with the second largest and $50 to the man with the third largest. Besides this, a section prize of $100 and a five-dollar hat to each member was offered for first man and $50 for second. Five sections were represented, with headquarters in New York, Philadelphia, San Francisco, Boston and Chicago. The New York section won the first prize with a total number of sales for the two months amounting to about $43,000. The Philadelphia section was second. The Hobart company manufactures electric coffee mills, meat choppers and grinders, cake mixers, etc., which are sold chiefly to grocers, butchers, hotels, etc. The company makes its own direct-current motors but buys its alternating-current motors from the Emerson Electric Manufacturing Company and the Western Electric Company.

New Equipment for Industrial Plants.—The Aluminum Company of America, Pittsburgh, Pa., will place in operation in its new plant at Massena, N. Y., eighteen 2500-kw rotary converters and nine 5000-kw water-cooled transformers. The Cyclops Iron Works, San Francisco, Cal., has recently ordered two 15-hp, four 30-hp and four 37-hp induction motors. The Crucible Steel Company, Milwaukee, Wis., intends to install soon one 500-kva and three 10-kva transformers. The John A. Roebling's Sons Company, Trenton, N. J., recently purchased fifteen 20-hp motors and starters. The Riter-Conley Manufacturing Company, Pittsburgh, Pa., has ordered seven small motors and six motors of 10-hp and ten of 25-hp rating. The Oldbury Electrical Chemical Company, Niagara Falls, N. Y., will place in operation in its plant a 500-kw rotary converter, three 175-kva transformers and a switchboard. The Lakeland Phosphate Company, Lakeland, Fla., will add to its power facilities electric apparatus consisting of a 937-kva alternating-current generator with a 35-kw turbo-exciter and a 35-kw motor-generator exciter set, a switchboard and accessories. The Portland Flouring Mills Company, Portland, Ore., has arranged to install in one of its subsidiary mills—the Puget Sound Milling Company, Tacoma, Wash.—a 500-hp induction motor with starting-compensator panel and two 100-kva transformers. The Standard Portland Cement Company, Leeds, Ala., will install four 75-hp induction motors in its plant. Spencer Kellogg & Sons, Inc., Buffalo, N. Y., manufacturers of linseed oil, will add to their electric-drive equipment a 1000-hp induction motor and a switchboard. The Excelsior Shoe Company, Portsmouth, Ohio, will install for electric drive a number of 2-hp and 3-hp motors and eighteen 5-hp motors. The Western Glass Company, Streator, Ill., will add to its electric-drive equipment two 200-hp induction motors and controllers. The Newport Mill Company, Newport, Tenn., will install a 25-hp, a 35-hp and a 75-hp induction motor in its plant. The Borden Condensed Milk Company, Elgin, Ill., will place in operation in its plant a new 150-kw alternating-current generator, eight 5-hp motors, a switchboard and accessories. The J. C. Hubinger Brothers Company, Keokuk, Ia., manufacturer of oils and dexterine, has arranged to install in its plant a 1270-hp synchronous motor with an 18-kw exciter, one 50-hp induction motor, two 100-hp induction motors and one 150-hp induction motor, with switchboard apparatus. The Western Brick Company, Danville, Ill., will install a 7.5-hp, a 35-hp and a 150-hp induction motor with compensators in its plant. The above equipment is to be furnished by the General Electric Company.

NEW YORK METAL MARKET PRICES

	May 19		May 25	
Copper	Bid	Asked	Bid	Asked
Standard spot*	13.65	14.00	13.70	14.12½
	Selling Prices		Selling Prices	
	£ s d		£ s d	
London, standard spot*	63 7 6		63 2 6	
Prime Lake	14.37½	to 14.50	14.37½	to 14.50
Electrolytic	14.10	to 14.20	14.10	to 14.20
Casting	13.95	to 14.05	13.95	to 14.05
Copper wire base	15.25	to	15.25	to .....
Lead	3.90		3.90	
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter	7.00		7.00	
Spelter, spot	5.15	to 5.25	5.10	to 5.20
Tin, spot	32.87½	to 33.12½	33.10	to 33.30
Aluminum:				
Prompt delivery	17.75	to 18.00	17.75	to 18.00
Future	17.75	to 18.00	17.75	to 18.00

***OLD METALS**

Heavy copper and wire	12.87½	12.87½
Brass, heavy	8.62½	8.62½
Brass, light	7.50	7.50
Lead, heavy	3.90	3.90
Zinc, scrap	4.15	4.15

***COPPER EXPORTS**

Total tons to May 25 27,878

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Amalgamated Copper Company Annual Report.—In the annual report of the Amalgamated Copper Company for the calendar year 1913 Mr. John D. Ryan, the president, says that the market for copper metal during the year was a reasonably good one, notwithstanding the fact that in the last quarter the domestic consumption fell off materially. Domestic consumption averaged in the six months commencing with November but 77 per cent of the rate of consumption during the year 1913 and but 73 per cent of that during the year 1912. The exports during this period of six months were sufficient not only to absorb the surplus left over after the domestic consumers were supplied but also to reduce the stock in the hands of producers in this country from 105,000,000 lb. at the end of 1912 to 70,000,000 lb. on May 1, 1914. The total stocks in Europe and the United States, which were 370,000,000 lb. at the end of 1909, had been reduced to 122,000,000 lb. on May 1, 1914. The prices obtained during the first four months of the year 1914 have not been as good as the average for the years 1913 and 1912, but, taking into consideration the very sharp falling off in domestic business during the last few months, Mr. Ryan concludes that even with domestic consumption below the normal, the future for the metal market is one of great promise.

Increasing Activity of Westinghouse Electric & Manufacturing Company.—Some of the figures of the annual report of the Westinghouse Electric & Manufacturing Company for the year ended March 31, 1914, were published in the *Electrical World* of last week. Supplementary information is published herewith. Property and plant are valued on the balance sheet at $20,054,595. The decrease of $412,649 in this item is due to the fact that the charges for depreciation of buildings and equipment exceeded the amount charged to capital account for additions to plant. Mr. Guy E. Tripp, chairman of the board of directors, says that it is a matter of considerable satisfaction that the company was able to show a large increase in sales billed during the year on the one hand and an actual net decrease in the property and plant account on the other. Patents, charters and franchises are valued at $6,128,239. During the year the balance of $1,540,000 of a total of $3,500,000 debenture certificates issued by the company in 1898 was retired. The situation regarding the foreign companies was explained in detail by Mr. Tripp. The latest advices from the liquidator of the Russian company indicate that in addition to the balance due the Westinghouse Electric & Manufacturing Company for cash advances there will be realized an amount sufficient to pay the greater part of the present book value of the investment in the debentures of the Russian company. At the annual meeting of shareholders of the British Westinghouse Electric & Manufacturing Company, Ltd., on April 6, 1914, a dividend of 5 per cent on the preference shares, the first since 1904, was declared out of the results of the 1913 operations. It is expected that this rate will be maintained as the company has now accumulated an ample cash working capital. The reduction in the book value of the investment in the shares of the Traction & Power Securities Company, Ltd., of London, is due to the repayment in cash of £2 per share on the par value of £10 per share. This company also paid a cash dividend of approximately 3½ per cent out of its income for the year 1913. The total of the investments in traction and power companies has been reduced during the year almost $2,000,000. This is partly due to depreciation but chiefly to the sale during the year of the investment in the securities of the Niagara, Lockport & Ontario Power Company. This sale resulted in a net profit over the book value at which these securities were carried as of March 31, 1913, certain depreciations having been made in previous years. Since the close of the fiscal year the directors have approved the sale of the investment in the bonds and in the majority of the capital stock of the Scranton & Wilkes-Barre Traction Corporation. The notes of the Security Investment Company, to which reference was made in the report for the previous year, have been depreciated to the nominal value of $1. The amount of the depreciation was charged against surplus. The reserve for notes and accounts receivable was again increased during the year. A decrease in the value of the working and trading assets as compared with the previous year is due to the decrease in volume of unfilled orders on hand. The book values have been verified by inventories which were valued at purchase prices or manufacturing costs or less. A small increase in the total of $7,066,864, other assets, is due to deferred charges, incidental to the renewal on Aug. 1 last of $3,250,000 of a total of $4,000,000 collateral notes due on that date. The balance of this expense will be charged off when the notes are paid on Aug. 1, 1914. The five-year notes, aggregating $429,500, issued to creditors under the plan for the discharge of the receivers in 1908, matured Jan. 1, 1914, and were paid. Collateral notes aggregating $3,500,000, placed during the previous year, were paid in full during the current year. An additional collateral loan of $1,250,000 was placed during the year and will be paid at maturity on June 29, 1914. The issue of three-year 6 per cent collateral notes due Aug. 1, 1913, was renewed to the extent of $3,250,000 for two years. The payment of the notes aggregating $4,500,000 will be made from the proceeds of sales of securities and therefore will not deplete the working cash capital of the company. Their payment will return to the treasury a large amount of surplus securities pledged thereunder and will leave outstanding but one issue of collateral notes, the ten-year 5 per cent notes due Oct. 1, 1917, amounting to $2,720,000. The surplus as of March 31, 1913, was $7,348,522. This was increased by the net income for the year and various items to a gross surplus of $12,002,305. By charges for 7 per cent dividends on the preferred stock and 4 per cent dividends on the common stock and miscellaneous charges aggregating $370,686 the gross surplus was reduced to $9,945,719. Against this there were charged depreciations and adjustments of investments and other assets amounting to $2,286,589, leaving a balance sheet surplus as of March 31, 1913, of $7,659,130. The book values of the investments of the company stood at the close of the year at the $22,104,481 as compared with $23,882,860 at the close of the previous fiscal year, or a decrease of $1,778,379.

Augusta-Aiken Corporation Earnings.—Gross earnings of the Augusta-Aiken Railway & Electric Corporation and subsidiary companies for the year ended Dec. 31, 1913, amounted to $725,073 as compared with $662,591 in the preceding year. Operating expenses, including taxes, amounted to $403,084 as compared with $369,438. Net earnings from operation were $321,989 in 1913 and $293,153 in 1912. Interest and sinking fund charges were $205,170 last year as compared with $193,211 in the previous year. The surplus was $116,819 in 1913 and $99,942 in 1912. Dividends of 6 per cent, or $90,000, were paid on the preferred stock in each year, leaving a surplus of $26,819 in 1913 and $9,942 in 1912. In comparison with the increase of 9.4 per cent in gross earnings from all sources, gross electric earnings increased 18.9 per cent with an increase in expenses of 23.4 per cent. F. Q. Brown, the president, says that expenses were higher in 1913 owing to an increase in wages of employees in the transportation department, an active new-business campaign in the lighting department, which resulted in a large increase in electric light and power sales, and the generation of a much larger output of energy to take care of new customers, which necessitated the use of the steam plant for a greater part of the time, the total available water-power supply from the city canal having been used. In addition to the expenditures for maintenance, $94,321 was expended for construction work, of which over one-half was for connecting and serving new customers in the electric department and $11,873 was for an addition to the switchboard to control the apparatus of both city plants in connection with the hydroelecric power from the Georgia-Carolina Power Company. The new hydroelectric development of the Georgia-Carolina Power Company, a subsidiary of the company, was formally dedicated on Feb. 17, 1914. The relations of the company with the city authorities, its own employees, and the public generally are, in the opinion of the officials, entirely satisfactory. With the materially improved business and financial conditions now existing throughout the South, and with a plentiful supply of energy at an economical price for industrial expansion, the officials look forward hopefully to the future growth of Augusta and the properties of the company.

Business Notes

The Olston Electric Stove Company, of Los Angeles, Cal., announces that J. K. Tennant is now manager of the company.

K. McLennan & Company, of Chicago, Ill., have removed their office from 431 South Dearborn Street to 412 South Fifth Avenue.

The Multi-Refillable Fuse Company, of Chicago, Ill., has moved to larger quarters. The new address is 723 West Fulton Street.

The Railway & Industrial Engineering Company has moved its factory and main offices from Pittsburgh to Greensburg, Pa.

The Electric Products Company, of Cleveland, Ohio, announces that O. P. Smith has been appointed manager of its Chicago office.

Lloyd Donaldson, electrical engineer and contractor, has moved from 221 South Tenth Street to 305 North Ninth Street, Boise, Idaho.

The Connecticut Telephone & Electric Company, of Meriden, Conn., announces that W. J. Johnston, of Chicago, Ill., has joined its sales force.

W. N. Matthews & Brother, of St. Louis, announce that James R. Kearney, formerly of the Western Electric Company, will be their special representative.

Hubbard & Company, of Pittsburgh, Pa., announce that Victor L. Crawford, formerly traveling salesman for W. N. Mathews & Brother, is now representing them.

Meirowsky Brothers have moved to 106 Broadway, Jersey City, N. J., where they have about ten times as much space as they had at their former quarters in New York.

The United States Equipment Company, of Chicago, Ill., announces that its offices have been moved to the Continental and Commercial Building, 208 La Salle Street, Chicago.

The Pittsburgh High Voltage Insulator Company, of Derry, Pa., has changed the address of its Los Angeles office from 120 South Los Angeles Street to 757 South Los Angeles Street.

The Robbins & Myers Company, of Springfield, Ohio, has removed its Philadelphia office from the Bailey Building, Room 206, to the Bellevue Court Building, Room 606, 1418 Walnut Street.

M. B. Wheeler has opened an office at 1015 Union National Bank Building, Houston, Tex., as electrical manufacturers' agent. Mr. Wheeler says that "Everything electrical" is his slogan.

The Goodsell Packing Company, of 31 West Lake Street, Chicago, Ill., a new corporation, is to handle various kinds of packing known as "Goodsell" packing. B. W. Goodsell is president and manager.

The Menominee Electric Manufacturing Company, of Menominee, Mich., announces that the Bressan-Young Company, 6 Church Street, New York, has been appointed its Eastern representative.

Harvey Deschere & Company have moved their main office, formerly at 50 Church Street, New York, to the works at 1507 Garden Street, Hoboken, N. J., where the office and works will be combined.

Baeuerle & Morris, of Philadelphia, Pa., announce that the interests of the late Alfred P. Morris have been purchased by Sydney S. Morris and that the business will be continued under the old firm name.

W. G. Watson & Company.—W. G. Watson, of the firm bearing his name at Sydney, Australia, is visiting the United States for the purpose of establishing business relations with manufacturers of electrical supplies.

J. Ed. Erickson, formerly with Thomas G. Grier in Chicago, and more recently with the Erner Electric Company, of Cleveland, has formed a connection with the Western Conduit Company, of Youngstown, Ohio.

William C. Tregoning has established an office and laboratory at 813 Prospect Avenue S. E., Cleveland, Ohio. Mr. Tregoning was formerly president and general manager of the Tregoning Electric Manufacturing Company.

The United States Light & Heating Company, of Niagara Falls, N. Y., announces that a sales office has been established in Washington, D. C., in the Evans Building, 1420 New York Avenue, with W. G. Davis in charge.

Electrical Engineers' Equipment Company, designer and builder of power-plant appliances, has moved to 711 West Meridian Street, Chicago. J. C. Farrar & Company, Los Angeles, Cal., have been appointed its Pacific Coast agents.

The Cutler-Hammer Manufacturing Company announces that Paul W. Jones has been transferred from its New York factory to the sales engineering department, with headquarters in the Farmers' Bank Building, Pittsburgh, Pa.

The Sun Electric Company, Burrage, Mass., manufactures sockets, fuse plugs, cut-outs, switches, etc. G. B. Levy is the president of this new concern, S. O. Reinstein is vice-president, J. Nelson is treasurer, and Frank Langford is secretary and manager.

The L. E. Myers Company of Illinois has transferred its business to the L. E. Myers Company of Delaware. The new company is capitalized at $250,000. The offices of the company will be maintained at Chicago at the same address as that of the old company.

The Buffalo Foundry & Machine Company, of Buffalo, N. Y., is no longer being represented by H. E. Jacoby in New York City and vicinity. This company is now handling direct all inquiries covering vacuum apparatus, castings, patterns and machine work.

The Electric Products Company, of Cleveland, Ohio, announces that J. Preston Lyons has been elected secretary of the company with headquarters at Cleveland. Mr. Lyons has been manager successively of the company's offices at Mobile, Ala.; Buffalo, N. Y., and Chicago, Ill.

Charles Eshleman, general sales manager of the Adams-Bagnall Electric Company, Cleveland, Ohio, has left that company to become vice-president and sales manager of the Union Metal Manufacturing Company, of Canton, Ohio, which is preparing to double the capacity of its plant in that city on account of its rapidly increasing business.

The Alaska-Washington Purchasing Bureau, of Seattle, Wash., has been organized for the purpose of representing firms and individuals in purchasing and forwarding stocks and supplies of every description. E. C. Gaumintz, formerly purchasing agent for the Puget Sound Traction, Light & Power Company, is the purchasing agent of this company.

The Santo Manufacturing Company, of Philadelphia, Pa., announces that it has purchased the patents and manufacturing facilities of the Keller Manufacturing Company. A. H. Boyd, who has been manager of the Philadelphia office of the Fort Wayne Electric Works, has resigned his position to become general manager and treasurer of this company.

New Industrial Companies

The Court Electric Company, of Boston, Mass., has been incorporated with a capital stock of $20,000. The directors are William P. St. George, president; John V. Quinlan, of Brookline, treasurer, and J. J. Gaffney.

The Rupp-Skeldon Motor Company, of Toledo, Ohio, has been incorporated with a capital stock of $50,000 to manufacture and deal in electric motors. The incorporators are Robert G. Young, James Nye, James Greenwald and B. W. Johnson.

The Amo Manufacturing Company, of New York, N. Y., has been incorporated by Herman Frieder, H. G. Wear and F. W. Schmidt, 159 Jewett Avenue, Jersey City, N. J. The company is capitalized at $5,000 and proposes to manufacture and deal in electrical novelties.

The National Electric Distributer Corporation has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $500,000 and proposes to manufacture and deal in machinery to generate electricity. The incorporators are H. E. Latter, W. J. Maloney and O. Reichard, of Wilmington, Del.

The Stephens Gas-Electric Chandelier Company, of Kansas City, Mo., has been granted a charter with a capital stock of $20,000. The incorporators are S. S. Stephens, W. C. Chapman and E. G. Stephens.

The Miami Electrical Supply Company, of Peru, Ind., has been chartered with a capital stock of $10,000 to manufacture and deal in electrical supplies. The directors are E. Trautman, John Bethel and Samuel Fowden.

The MacLewee Electric Company, of Trenton, N. J., has been incorporated by W. S. MacLewee, H. M. Hartman and F. R. Brace, of Trenton, N. J. The company is capitalized at $100,000 and proposes to manufacture electrical appliances, etc.

The Universal Sign & Letter Company, of Brooklyn, N. Y., has been incorporated by H. A. Jourdan, E. Breuer and L. Cohen, of Brooklyn, N. Y. The company is capitalized at $50,000 and purposes to manufacture and deal in electric signs and novelties.

The Willis Mitchel Company, of New York, N. Y., has been incorporated by A. B. Britton, J. J. Jansen, Jr., and W. P. Powell, of New York, N. Y. The company is capitalized at $100,000 and purposes to install light, heat and power systems and deal in machinery, etc.

The Columbian Electric Vehicle Company has filed articles of incorporation with a capital stock of $300,000 under the laws of the State of Delaware. The company purposes to manufacture vehicles of all kinds. The incorporators are W. M. Pyle, G. G. Stiegler and L. W. E. McCarthy, of Wilmington, Del.

Trade Publications

Fans.—A pocket edition of its 1914 fan catalog has been issued by the Sprague Electric Works of the General Electric Company.

Fans.—Westinghouse 56-in. ceiling and column fans are illustrated and described in Folder 4282, issued by the Westinghouse Electric & Manufacturing Company.

Outdoor Substations.—An illustrated flier showing several types of modern outdoor high-tension substations is being distributed by the Delta-Star Electric Company, 617 West Jackson Boulevard, Chicago, Ill.

Motors.—Direct-current motors, types C and D, are discussed in Bulletin No. 41,010 issued by the Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York. Their application to various purposes is well illustrated.

Automobiles.—The handsome catalog of the Anderson Electric Car Company, Detroit, Mich., shows some splendid new models of the "Detroit Electric" car. Specifications of each car are given, as well as a description of some of the principal parts of the automobile.

Crane Motors.—Leaflet 2364 of the Westinghouse Electric & Manufacturing Company describes its direct-current crane motors. These motors are designed for severe intermittent, varying-speed service where high starting torque is required. Detailed views of the motors are given and the more important features of construction described.

Household Electric Iron.—Folder 4281 describes the household and travelers' iron manufactured by the Westinghouse Electric & Manufacturing Company. On the front page is a picture of the cutout representing "Dorothy" ironing. This device is furnished to dealers and central stations by the company for use in their selling campaigns.

Motor-Driven Pumps.—Section 3082, a publication of the Westinghouse Electric & Manufacturing Company, describes various kinds of electrically driven pumps. The booklet is freely illustrated. Tables are given showing the frictional heat in wrought-iron pipe, horse-power for pumping, standard dimensions of pipe and atmospheric pressures, equivalent heads and suction lifts.

Laundry Machinery.—The Westinghouse Electric & Manufacturing Company has recently issued Section 3164, which covers motor-driven laundry machinery. It describes the qualifications necessary for motor drive in laundry work. A number of installations are also described, showing the amount of power required for the various machines and also the monthly energy consumption of the different plants.

Map of Mexico.—The Central Electric Company, 320 South Fifth Avenue, Chicago, Ill., is sending out to the electrical trade a map of Mexico showing the position of the United States forts along the Mexican border and the position of the United States fleet in Mexican waters. In the lower left-hand corner of the map, following brief reference to the company being "first in service," are mentioned a few of its specialties.

Lighting Fixtures.—A handsome and instructive catalog illustrating and describing "ideal lighting" has just been issued by the Central Electric Company, 326 South Fifth Avenue, Chicago. Eighteen of the fixture units shown may be equipped with the new high-efficiency tungsten lamps. The illustrations in the catalog show a decidedly attractive line of fixtures ranging from plain Doric designs to the ornate Louis XVI styles.

Lamp Standards.—A booklet of forty pages bearing the imprint of the King Foundry Company, St. Joseph, Mo., contains "A Story of Modern Merchandising." It tells in an interesting manner of the development of light as an aid in selling merchandise as well as an important factor in building up retail sections. It leads up to the story of what the "King White Way" is, and describes the structure, designs and other features of its ornamental poles. Almost any of the classic types of standards and fixtures illustrated would add beauty to a city thoroughfare.

Electric Toaster.—The title of a recent publication of the Copeman Electric Stove Company, Flint, Mich.—"The Toaster That Turns the Toast"—will attract attention. A distinctive feature of this toaster is a knob which controls the tray on which the bread rests. By the turn of a knob the bread can be toasted first on one side and then on the other without handling it and without burning the fingers. The booklet contains illustrations of suggested window displays for dealers and other advertising helps, and attached to one of its pages is a well-prepared smaller booklet (size 3½ in. by 5½ in.) for distribution to consumers.

Chandeliers and Other Fixtures.—A new and distinctive catalog is that of the Beardslee Chandelier Manufacturing Company, 216-220 South Jefferson Street, Chicago, illustrating and describing the varied chandeliers and other lighting fixtures of this house. The book contains about 220 pages, 10 in. by 13.5 in. in size. It is handsomely and profusely illustrated, one plate in colors showing the tints for art glass referred to in the catalog. The manufacturer makes the point that all chandeliers ordered from this catalog in the finishes listed will be shipped in twenty-four hours. Prices are given, and the book forms a valuable reference work for engineers, architects, contractors, dealers and others interested in lighting fixtures.

Locomobiles.—A 112-page catalog has been issued by Heinrich Lanz, Mannheim, Germany, in which are described and fully illustrated the portable and semi-portable self-contained engines made in the works of Herr Lanz. Some interesting interior views of the Lanz shops are followed by comprehensive descriptions of the various types of engines made by this firm, and expert opinions and test reports are also given. Pictures of some industrial plants and central stations in Europe which are driven by Lanz semi-portable engines lend interest to the catalog. An attractive cover incloses the well-arranged reading matter. The Wiener Machinery Company, 50 Church Street, New York, is sole representative of the Lanz products in the United States.

Marine Service Equipment.—Four pamphlets have recently been published by the Westinghouse Machine Company, East Pittsburgh, Pa., with the general title "Application of the Westinghouse Machine Company's Products to Marine Service." Each part of the equipment is treated in a separate publication, under the following heads: "Steam Turbine," "Reduction Gear and Dynamometer," "Bridge Control" and "Condensers and Auxiliaries." A fifth pamphlet gives a description of the Westinghouse gear and dynamometer for marine service. The publications contain much useful information on the electric propulsion of ships and the application of Westinghouse machinery to this purpose. The excellent illustrations make an effective accompaniment to the text.

Personal Mention

Mr. J. H. Ward, formerly of Tottenham, Ont., has been placed in charge of the electric-light plant at Acton, Ont.

Mr. Thomas Henry, for many years chief engineer of the Interurban Electric Company of West Toronto, Ont., has been appointed electrical inspector for the city of Toronto.

Mr. J. C. Grimes, who was formerly connected with the municipal light and water system at Grove, Okla., is now superintendent of the Harrison (Okla.) Gas & Electric Light Company.

Mr. J. Morris has been appointed engineer in charge of the municipal electric light and water-works plant at Newmarket, Ont., succeeding Mr. W. O'Hara, resigned. Mr. Morris was formerly at Mount Forest.

Mr. A. H. Ford has resigned as president of the Birmingham (Ala.) Railway, Light & Power Company, effective June 1, to become vice-president and general manager of the Cumberland County Power & Light Company, of Portland, Maine.

Mr. A. H. Robbins, formerly electrical engineer for the Electric Light & Power Company of Abington and Rockland, North Abington, Mass., has accepted a position as consulting engineer, specializing in electrical engineering, with the General Engineering & Construction Company of New York.

Mr. George Kidd has been appointed general manager of the British Columbia Electric Railway Company, Ltd., of Vancouver, B. C., to succeed Mr. R. H. Sperling, whose promotion as assistant to the chairman of the board in London was noted in these columns on April 25, 1914. Mr. Kidd was formerly secretary of the company in London, and since he has been located at the Vancouver office has filled the position of comptroller.

Mr. Allen B. Gates, until recently testing engineer of the Sanitary District of Chicago, has been promoted to the position of operating engineer. Mr. Gates is a graduate of Purdue University in electrical engineering, class of 1909, and took post-graduate work at the University of Illinois. For four years he has been connected with the District, in Electrical Engineer Ellicott's department. He has made an excellent record.

Mr. J. S. Pevear, vice-president of the New Orleans (La.) Railway & Light Company, has been elected president of the Birmingham (Ala.) Railway, Light & Power Company as successor to Mr. H. S. Ford, who resigned to accept the position of general manager of the Cumberland County Power & Light Company, of Portland, Maine, as announced elsewhere in these columns. The Birmingham company is a subsidiary of the American Cities Company.

Mr. E. C. Gaumnitz has resigned as purchasing agent of the Puget Sound Traction, Light & Power Company, Seattle, Wash. Mr. Gaumnitz was born in St. Cloud, Minn., on Feb. 24, 1882. He went to Seattle with his parents in 1890, and was educated in the public schools. Mr. Gaumnitz entered the employ of the Western Union Telegraph Company about 1896 and remained in its employ until 1899, when he accepted a position in the office of the general superintendent of the Seattle Electric Company.

Mr. Samuel G. McMeen, of Columbus, Ohio, has accepted the presidency of the Ohio State Telephone Company, soon to be formed, it is said, by the consolidation of the United States Telephone Company, the Cuyahoga Telephone Company and other independent concerns, to compete with the American Telephone & Telegraph Company an dits subsidiary companies. Mr. McMeen is a member of the firm of McMeen & Miller, of Chicago, and is president of the Columbus Railway & Light Company.

Mr. Robert Colgate Wood was nominated on May 19 by Governor Glynn as a member of the Public Service Commission for the First District of New York to succeed Mr. John E. Eustis, whose term expired on Feb. 1. Mr. Wood is forty-four years old. He was graduated from Harvard University and has lived at Riverdale in the Borough of the Bronx practically all his life. After leaving Harvard Mr. Wood engaged in the banking and brokerage business with Mr. J. Craig Havemeyer. He was one of the organizers and a director of the New York City Interborough Railway, a crosstown surface line in the Bronx which served as a feeder to the subway and elevated lines. The company is now included as part of the system of the Third Avenue Railway.

Mr. Samuel G. Neiler, who has been nominated as chairman of the Chicago Section of the American Society of Mechanical Engineers, is one of Chicago's prominent engineers. Mr. Neiler has had a wide experience and takes high rank as an authority on details of power-plant service, particularly steam piping and high-pressure hydraulic transmission work for industrial plants. He is president of the engineering firm of Neiler, Rich & Company. In addition to his membership in the American Society of Mechanical Engineers, Mr. Neiler is a fellow of the American Institute of Electrical Engineers and a member of Franklin Institute, the Illuminating Engineering Society, the American Society of Heating and Ventilating Engineers, the National Electric Light Association, the American Association for the Advancement of Science, the New York Railroad Club and the (British) Institution of Electrical Engineers. He was a special student in the mechanical engineering course in Massachusetts Institute of Technology, class of 1888. He took post-graduate work at the University of Minnesota and from 1889 to 1892 was connected with the Thomson-Houston Electric Company at Lynn and Boston. He was responsible for much of the work done in the early development of the search-lantern projector, and he is said also to have done the first real work in the standardization of methods of pole-line construction. From 1892 to 1894 Mr. Neiler was assistant electrical engineer of the World's Columbian Exposition in Chicago. He designed much of the special equipment, laid out a large portion of the work and was directly in charge of all detail construction. It is difficult at this time to realize the almost entire lack of precedent for much of the electric-service work that was undertaken on the exposition grounds. Mr. Neiler's engineering resourcefulness and ingenuity were brought out at the Chicago World's Fair, and he introduced many original ideas in the electric service of that extensive and beautiful exposition. He wrote the report for the electrical engineering department of the exposition. From 1894 to the present time Mr. Neiler has been in professional practice in Chicago. At the Louisiana Purchase Exposition of 1904 he was a member of the jury of awards on steam engines and chairman of the condenser committee. He has designed a large number of plants and equipments, nearly all of them distinguished by originality of execution in adapting means to ends.

SAMUEL G. NEILER

Obituary

George Millard, of Burlington, Ia., secretary of the Citizens' Water Company and for many years connected with the Murray Iron Works Company, died May 4.

W. M. Sheehan, president and treasurer of W. M. Sheehan & Company, electrical engineers and contractors of New York, died at his residence in Newark, N. J., May 23. Mr. Sheehan had been identified with the electrical industry for more than thirty years and was one of the first employees of the Thomson-Houston Company of Lynn, Mass., In 1883 he went to Newburgh, N. Y., in the interest of the Thomson-Houston Company and soon afterward became superintendent of the Newburgh Light, Heat & Power Company. For several years he was identified with the Hyer-Sheehan Electric Motor Company, and with the firm of Sheehan & Hewett, of Newburgh. For fifteen years past Mr. Sheehan had been actively engaged in business in New York City and for several years had been the managing director of the Suffolk Light, Heat & Power Company of Southampton, N. Y.

Construction

New England

GUILFORD, MAINE.—The Greenville Lt. & Pwr. Co., of Greenville, has applied to the Board of Selectmen for a franchise to supply electricity for lamps and motors in Guilford.

MANCHESTER, N. H.—Preparations are being made by the Manchester Trac., Lt. & Pwr. Co. to place all its electric wires in the business district underground, at a cost of about $125,000, to be completed in five years.

MIRROR LAKE, N. H.—Plans are being considered to secure electrical service for this part of Tuftonboro from the municipal electric-light plant in Wolfeboro, which already has erected a transmission line to the Tuftonboro line.

FITCHBURG, MASS.—The Fitchburg Gas & El. Lt. Co. has acquired the public lighting franchise in Ashby and Townsend.

MELROSE, MASS.—The Board of Aldermen has approved the contract with the Malden El. Co. for the installation of an ornamental street-lighting system on Main Street.

TOWNSEND, MASS.—The Fitchburg Gas & El. Co., of Fitchburg, is reported to have acquired control of the public lighting franchise owned by U. S. Adams & Co., of Townsend.

WEST SPRINGFIELD, MASS. — The electric distributing system in West Springfield, together with a franchise for a period of ten years for supplying electricity to the town and residents, has been sold by the Board of Selectmen to the United El. Lt. Co.,of Springfield, for $21,000 ($12,000 for system and $9,000 for franchise). The terms agreed upon assure the placing of the wires underground on Main Street and on Park Avenue as far as Elm Street.

PROVIDENCE, R. I.—Plans are being considered by the City Council for the eventual installation of about 7000 of the new nitrogen incandescent street lamps in the outlying sections of the city, to replace the present carbon incandescent lamps.

WARWICK, R. I.—The Narragansett El. Ltg. Co., of Providence, is planning to replace the 32-cp incandescent street lamps now in use with 50-cp lamps. It is understood that a few of the 350-cp nitrogen lamps will be installed. Arthur B. Lisle is general manager.

Middle Atlantic

ALBANY, N. Y.—Bids will be received by the trustees of public buildings, Executive Chamber of the State Capitol, Albany, until June 10, for electric wiring and fixture hoists in the Assembly chamber of the State Capitol, Albany. Drawings and specifications may be consulted and blank forms of proposal obtained at the office of Lewis F. Pilcher, State architect, Capitol, Albany.

BUFFALO, N. Y.—The New York & Buffalo Steamship Co., recently organized with a capital stock of $3,500,000, proposes to operate 30 electrically driven vessels on the State Barge Canal. Charles W. Morse, of New York, is interested in the company.

NEW YORK, N. Y.—The Bureau of Franchises of the Board of Estimate has reported in favor of granting the application of the Yonkers El. Lt. & Pwr. Co., the Westchester Ltg. Co., the New York Edison Co. and the United El. Lt. & Pwr. Co. for permission to maintain an electric transmission line along the Catskill Aqueduct lands in Westchester County.

NEW YORK, N. Y.—Bids will be received by the Board of Water Supply, twenty-second floor, Municipal Building, Park Row, Center and Chambers Streets, New York, until June 9, on Contract 148, for the construction of the portion of the Catskill Aqueduct telephone system extending from Croton Lake to the northern boundary line of the city of New York, a distance of approximately 28 miles. The pole line has been built under another contract. Pamphlets containing information for bidders and contract drawings can be obtained at the office of the secretary, twenty-second floor, Municipal Building, upon deposit of $10 for each pamphlet. W. Bruce Cobb is secretary.

NEW YORK, N. Y.—The Public Service Commission has authorized the Long Island Ltg. Co., of New York, to issue $90,000 in bonds and $35,000 in capital stock, the proceeds to be used for new construction and improvements to its transmission system. A new 1250-kw turbo-generator set, new coal-handling apparatus and a 300-hp boiler will be installed at the Northport plant, and the docks at Northport will be lengthened 50 ft. Improvements will be made at Brentwood, Islip, Amityville, Ronkonkoma and Sayville. The distribution lines of the company will be increased 12 miles and 250 additional services to consumer installed. The company supplies electricity in Northport, Centerport, Kings Park, Amityville and other towns on Long Island.

WEEDSPORT, N. Y.—At an election held recently the proposal to issue $18,000 for a municipal electric-light plant was carried. It is proposed to secure electricity to operate the system from the Empire Gas & El. Co., of Geneva, which distributes Niagara power in this section of the State.

ARENDTSVILLE, PA.—The Borough Council has entered into a contract with R. B. Myers for lighting the streets of the borough with electricity. The service will be furnished from the plant in the mill owned by Mr. Myers.

NEW CASTLE, PA.—William Wray, manager of the McDougal & Wray Theater, it is reported, is contemplating the installation of a private electric plant.

PHILADELPHIA, PA.—Plans and specifications have been completed and bids are being taken for a power house to be erected at Fortieth and Spruce Streets for the Thomas W. Evans Museum and Institute Society. John T. Windrim is architect.

PHILADELPHIA, PA.—Sub-bids are being asked by Braun & Stewart, of Philadelphia, contractors, for construction of power house for the North Philadelphia station of the Pennsylvania R. R. Co. William Cookman, Broad Street Station, is architect.

PHILADELPHIA, PA. — An ordinance appropriating $60,000 for the construction of a new heating and power plant for the Home for the Indigent at Holmesburg, a suburb of Philadelphia, has been signed by Mayor Rudolph Blankenburg. Plans, it is reported, will soon be completed and bids for construction of the plant will be asked in about 30 days.

PHILADELPHIA, PA.—Bids will be received by A. F. Hammond, superintendent of supplies, at the office of the Board of Public Education, Room 392, City Hall, Philadelphia, until June 9, for lighting fixtures for the following school buildings: William Cullen Bryant, Sixtieth Street and Cedar Avenue; James Martin, Richmond and Ontario Streets, and Overbrook, Sixty-second Street and Lebanon Avenue; also for program clocks and window shade carriers. Specifications, etc., can be obtained at the office of the superintendent of supplies, Room 392, City Hall.

PITTSBURGH, PA.—Bids will be received at the office of the secretary, board of education of Pittsburgh, 725 Fulton Building, Pittsburgh, until June 9 for furnishing electrical supplies.

YORK, PA.—The Merchants' El. Lt., Ht. & Pwr. Co. and the Edison Lt. & Pwr. Co., of York, it is reported, have decided to consolidate. A number of prominent business men, it is stated, will form a company and establish another electric-light plant.

BURLINGTON, N. J.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 17 for construction complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Burlington, N. J. Drawings and specifications may be secured at the above office or from the custodian of site. O. Wenderoth is supervising architect.

HAMBURG, N. J.—The Hardyston Township committee is preparing plans for the installation of a street-lighting system in Hamburg.

RAHWAY, N. J.—We are informed that the matter of establishing a municipal electric-light plant has been postponed indefinitely. C. H. Lambert is city clerk.

BRUNSWICK, MD.—The Town Council has granted the Harper's Ferry El. Lt. & Pwr. Co., of Harpers Ferry, W. Va., a 20-year franchise to furnish electricity in Brunswick.

CUMBERLAND, MD.—The Edison El. Illg. Co., of Cumberland, has awarded to the Wright, Richardson Co., of Cumberland, a contract for the construction of new power house and the erection of 1½ miles of transmission line. The new plant will have an output of 6500 hp. George W. Eyler is electrical engineer.

CLIFTON FORGE, VA.—The Virginia Western El. Co., of Clifton Forge, it is reported, is contemplating the erection of a transmission line from Clifton Forge to Ronceverte, W. Va.

ROCKY MOUNT, VA.—The Light & Pwr. Co., of Rocky Mount, has increased its capital stock from $15,000 to $20,000.

WILLIAMSBURG, VA.—The Bryant Lumber Co., it is reported, will install a 100-hp generating unit (directly connected) to furnish electricity for lamps and motors in Williamsburg. R. M. Bryant, of Franklin, is secretary.

WASHINGTON, D. C.—Bids will be received by the Engineer Department, Washington Barracks, D. C., until June 12 for furnishing motor-driven centrifugal pumps. Further information may be obtained on application to Lt.-Col. Joseph E. Kuhn.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, Room 509, District Building, Washington, until June 1 for furnishing cast-iron lamp-posts for use in the Electrical Department. Specifications and form of proposal may be obtained from the purchasing office, Room 320, District Building, Washington.

WASHINGTON, D. C.—Bids will be received at the office of the superintendent, United States Capitol Building and Grounds, Washington, D. C., until June 1 for installing at Columbia Hospital for Women, Pennsylvania Avenue, two electric passenger elevators, one electric service elevator, six electric dumbwaiters, one hydraulic sidewalk elevator and the mechanical equipment for same. Further information may be obtained upon application to Elliott Woods, superintendent.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 16 to be delivered at the various navy yards and naval stations the following supplies: Newport, R. I., Schedule 6832—three electric furnaces. Narragansett Bay, R. I., Schedule 6835—for installing underground telephone system as shown on drawing 646-13. Brooklyn, N. Y., Schedule 6839—one 110-hp induction motor, type A, class 1, 2200 volts, three-phase, 60 cycles; Schedule 6830—6000 ft. interior-communication plain 4-conductor and 10-conductor cable, 148,000 ft. flexible, double, plain, insulated conductor for portables, 2000 ft. solid, cotton-covered, rubber-insulated wire for ignition circuits for combustion engines, 54,700 ft. galvanized, soft-steel, leaded and armored twin-conductor wire; Schedule 6829—30,000 ft. solid, single, rubber-insulated lighting and power wire. Annapolis, Md., Schedule 6831—one motor-driven, 40-in. by 60-in. non-reversing, suction, dry-room tumbler. Boston, Mass., Schedule 6827—annual supply galvanized, crucible wire, cast-steel, annual supply annealed and galvanized, crucible cast-steel wire, annual supply plow-steel wire. Norfolk, Va., Schedule 6834—one motor-driven 24-in. chucking and bar combination lathe, one motor-driven 30-in. screw-cutting rapid-reduction lathe, two motor-driven, combined vertical and horizontal milling machines. Bids will also be received until June 23 as follows: Mare Island, Cal., Schedule 6824—one motor-driven hydraulic test pump. Bids will also be received at the same place until June 23 as follows: Mare Island, Cal., Schedule 6824—two motor-driven portable bench drills; Schedule 6813—one motor-driven combination saw and dado machine. Bids will also be received until June 30 for 10 radio sets (2-kw and 5-kw) for ship installation, to be delivered at the Brooklyn navy yard as per Schedule 6811. Applications for proposals should designate the schedule desired by number.

North Central

ALBION, MICH.—The Commonwealth Pwr. Co., it is reported, contemplates the installation of a new tungsten street-lighting system in Albion.

BATTLE CREEK, MICH.—Efforts are again being made to extend the ornamental lighting system on West Main Street to Washington Street and on Washington Street to the Sanitarium Annex.

GLADSTONE, MICH.—The electric light commission expects to purchase within the next eight months poles, wire, etc., for a 2-mile extension. The commission also contemplates the installation of either magnetite-arc lamps or series tungsten lamps to replace the 48 series-arc lamps now in use. G. A. Frogner is superintendent.

THREE RIVERS, MICH.—The Middle West Utilities Co., of Chicago, Ill., has purchased the controlling interest in the Three Rivers Lt. & Pwr. Co. T. L. Arnold is treasurer and manager.

BRADFORD, OHIO.—The installation of a small electric-light plant, to cost $2,000, is under consideration.

CAMBRIDGE, OHIO.—The New Midland Pwr. & Trac. Co., of Cambridge, has purchased a site on the B. & O. road, near the plant of the Guernsey Earthenware Co., on which it will erect a substation to

transform energy taken from the high-tension transmission line from Coshocton for distribution in Cambridge.

CINCINNATI, OHIO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 8 for repairs to the heating system, etc., in the United States custom house in Cincinnati, Ohio. For details see proposal columns.

CLEVELAND, OHIO.—The Cleveland El. Illg. Co. has taken out a permit for the construction of an addition to the engine room to its power plant at 712 East Seventieth Street, to cost about $7,000.

COLUMBUS, OHIO.—Arrangements, it is reported, have been made for financing a company to build a large central station at Floodwood, Ohio, in the Hocking Valley coal fields, from which electricity would be transmitted to towns and coal mines within a radius of 75 miles. Close & Co., of London, Eng., are said to be interested with other English capitalists in the project. F. C. Elliott, of Chicago, Ill., as trustee, will carry the plant through the construction stage. Herman Gamper, formerly superintendent of the municipal plant at Columbus, is engineer in charge.

LORAIN, OHIO.—The City Council has appointed a special committee, consisting of Mayor J. J. Pollock, Service Director Lewis and Council President George Alleman to make investigations and report on the feasibility of installing a municipal electric-light plant.

LOVELAND, OHIO.—The receiver of the Loveland El., Ice & Wtr. Co. has obtained authority from the court to dispose of the property of the company, including power and ice plants, which will be sold at auction on June 6. The estimated value of the property is placed at $75,000.

NORWALK, OHIO.—The City Council, it is reported, will soon call an election to submit the proposal to issue $120,000 in bonds for the installation of a municipal electric-lighting system to the voters.

YOUNGSTOWN, OHIO.—Bonds to the amount of $1,000,000, it is reported, will be issued by the Mahoning Valley Street Railways system, controlled by the Republic Ry. & Lt. Co., to finance improvements in its plants and railways within the next year.

WINCHESTER, KY.—George E. Tomilson, of Winchester, it is reported, is expecting to purchase one 75-kw to 100-kw, three-phase, 60-cycle, 220-volt generator and 20 motors, from 5 hp to 20 hp.

EAST CHICAGO, IND.—The Public Service Commission has granted the Northern Indiana Gas & El. Co., of East Chicago, $1,020,000 in bonds and $282,000 in notes, the proceeds to be used for the construction of a new plant in East Chicago.

JEFFERSONVILLE, IND.—The City Council is considering the question of establishing a municipal electric-light plant in Jeffersonville.

KOKOMO, IND.—Within the next three months the Indiana Rys. & Lt. Co., of Kokomo, expects to erect approximately 35 miles of transmission and distribution lines and transformers to supply electricity to rural districts and small towns. P. H. Palmer is assistant general manager and electrical engineer.

WINAMAC, IND.—The Town Council is considering a proposal submitted by Mr. Marvin, civil engineer, of Frankfort, for the installation of a power plant in Winamac.

AVON, ILL.—Within the next two months the Avon Milling & Mfg. Co. expects to purchase a 40-kw, 50-kw or 60-kw, 250-volt direct-current generating unit (directly connected) and one carload of 25-ft., 6-in.-top poles; also electrical appliances and supplies, including heating and cooking apparatus, vacuum cleaners, washing machines, wiring supplies, etc. George A. Tompkins is secretary and treasurer.

LOCKPORT, ILL.—The Public Ser. Co. of Northern Illinois, of Chicago, which, it is reported, has taken over the municipal electric-lighting system, is contemplating rebuilding the entire lighting system.

ROCK FALLS, ILL.—The Illinois Northern Utilities Co., of Chicago, is reported to have purchased the electric power franchise owned by Paul Dillon in Rock Falls. The company, it is expected, will extend its transmission lines into Rock Falls immediately.

ROCK ISLAND, ILL.—The People's Pwr. Co., of Rock Island, is planning to install a new street-lighting system consisting of 200 4-amp magnetite-arc lamps and 450 tungsten lamps of 100 cp, maintained by overhead wires, to cost about $30,000. Contracts have been placed for material. F. W. Reimers is general manager.

SPRINGFIELD, ILL.—Plans for a new fire-alarm system for the city have been submitted to the City Commissioners by Fred Spears, city electrician, to replace the present system. The plans provide for the installation of 150 boxes, at a cost of $30,000.

STERLING, ILL.—Bids are being asked by the city of Sterling for a boulevard lighting system, consisting of 82 posts, 8600 ft. of cable, transformer, etc. For specifications address Mayor A. J. Platt.

HUMBIRD, WIS.—The installation of an electric-light system in Humbird is under consideration. It is proposed to ask the Chippewa Valley Lt. & Pwr. Co., of Chippewa, to extend its service here.

MANITOWOC, WIS.—The cost of a new building and improvements for the municipal electric light and power plant is estimated at about $60,000.

ANOKA, MINN.—Within the next five months the city of Anoka expects to purchase material for distribution system, including poles, underground conduit, wire and meters. John Palmer is city manager.

AURORA, MINN.—The Village Council has decided to call an election to submit the proposal to issue $35,000 in bonds, of which $20,000 will be used for extensions and improvements to the municipal electric-light plant and $15,000 for the water-works system.

NEW YORK MILLS, MINN.—The installation of an electric-light plant in New York Mills is under consideration by the Council.

ST. JAMES, MINN.—Bids will be received until June 12 at the office of the Board of Education, St. James, Minn., for erection of an addition to the present high school building. Separate proposals to be submitted on general construction, heating and ventilating, plumbing and electric work. Plans and specifications are on file at the Minneapolis Builders' Exchange; copies may be obtained at the office of F. E. Halden, architect, Kasota Building, Minneapolis, upon deposit of $25, to be refunded upon return of plans. J. K. Sonnesyn is president of board.

ST. PAUL, MINN.—Extensive improvements will be made to the properties of the Consumers' Pwr. Co., a subsidiary of the Northern States Pwr. Co., during the current year. The Coon Rapids hydroelectric development on the Mississippi River is nearing completion and the initial unit of 21,000 hp will be in operation about Aug. 1. The plant when completed will have an output of 10,500 hp. A high-tension transmission line from St. Paul to near Northfield, a distance of 33 miles, will be erected to connect the hydraulic systems of the Faribault and Mankato systems. In addition to these there will be a number of extensions to transmission and distributing systems.

STAPLES, MINN.—Within the next four months the Board of Public Works expects to purchase water-softener outfit for water used in boilers at the municipal electric-light plant and an 8-in. by 12-in. boiler-feed pump. F. W. Findsen is secretary of light and water commission.

TWO HARBORS, MINN.—The city of Two Harbors is expecting to purchase coal loading and screening equipment for the municipal electric-light plant. A. Omtvedt is city clerk.

ALLISON, IA.—A franchise has been granted to the Hampton El. Lt. & Pwr. Co., of Hampton, to furnish electricity here for a period of 25 years. The company will extend its transmission line from Hampton to Allison.

DUBUQUE, IA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 2 for changes in plumbing, conduit and wiring system and lighting fixtures in the United States custom house and post office at Dubuque, Ia. For details see proposal columns. O. Wenderoth is supervising architect.

ESTHERVILLE, IA.—Plans are being prepared for extensions to water-works system and remodeling the municipal electric-light plant. J. F. Druar, of the Oscar Claussen Engineering Co., Commercial Building, St. Paul, Minn., is engineer in charge.

MASON CITY, IA.—All three franchises asked by the People's Gas & El. Co., controlled by the United Lt. & Rys. Co., were carried at an election held recently.

MILFORD, IA.—Preparations are being made for the installation of an electric-light and power plant in Milford. Electricity for operating the system will be obtained from the plant at Spirit Lake. Ralph Rodgers, of Milford, is engineer in charge. Messrs. Rassmussen and Nelson are interested in the project.

SAC CITY, IA.—The Sac City El. Co. is reported to have awarded a contract for the erection of a new generating plant.

WIOTA, IA.—The installation of an electric-lighting system in Wiota is under consideration.

HERMANN, MO.—The Hermann El. Lt. Co. expects to purchase within the next two months a 100-hp water-tube boiler.

PARNELL, MO.—Application has been made to the Council by the Grant City El. Lt. & Pwr. Co., of Grant City, for a franchise to furnish electricity in Parnell.

CHURCH'S FERRY, N. D.—The Commercial Club is considering the question of securing an electric-lighting system for the town.

HANKINSON, N. D.—The Otter Tail Co., of Fergus Falls, Minn., has purchased the property of the Phillips-Carlton El. Co., of Hankinson, and will extend its transmission line from Fairmont, N. D., to supply energy here. Other improvements will be made to the local system, involving a total expenditure of about $150,000.

BROOKINGS, S. D.—Extensions and improvements to the municipal electric-light plant, involving an expenditure of about $10,000 are under consideration.

EUREKA, KAN.—At an election held May 19 the citizens voted to grant R. M. Wilson, owner of the local electric-light plant, a 20-year electric-light franchise.

SHADY BEND, KAN.—The Shady Bend Milling & Pwr. Co. is expecting to erect within the next six months a transmission line to Beverly, a distance of 2½ miles, and will purchase material for same.

VALLEY FALLS, KAN.—The City Council, it is reported, has adopted resolutions providing for improvements to the electric-light plant. It is understood that new equipment, including engines and generators, will be purchased.

Southern States

WASHINGTON, N. C.—Bids will be received by the committee on improvements of the city of Washington until June 17 for mechanical and electrical equipment and for improvements to the electric-light plant as follows: Water-tube boilers, 400-kw engine-driven or turbine-driven generating units, exciters, switchboard, condensers and steam and centrifugal pumps. The construction work consists of buildings, foundations, concrete coagulating basin and filter tubs, filter plant, reservoir and radial brick chimney, and laying about 2½ miles of cast-iron pipe. Specifications and plans are on file in the office of the superintendent, Washington. Specifications, form of proposal and contract and plans will be mailed upon application to Gilbert C. White, of Charlotte, N. C., engineer, for which a deposit of $5 will be required for the specifications and form of proposal and contract and $5 for plans, which will be refunded upon return of same. H. B. Charles is superintendent.

LANDRUM, S. C.—The Tyron Ltg. Co., it is reported, contemplates the construction of an electric-light plant in Landrum.

McBEE, S. C.—A dam is being erected on Cedar Creek preparatory to installing an electric power plant, which will furnish electricity in McBee, Bethune and Big Springs Hotel. M. L. McCoy, of McBee, is interested in the project.

McPHERSON, GA.—Bids will be received at the office of the quartermaster, Fort McPherson, Ga., until June 10 for remodeling electric-lighting system. Major L. F. Garrard is quartermaster.

ATLANTIC BEACH, FLA.—The proprietors of the Atlantic Beach Hotel, it is reported, contemplate making improvements to the hotel, changing the lighting system from direct to alternating current, to install an ornamental street-lighting system, covering about 1 mile and to furnish electricity for street-lighting and for about 85 cottages; also to make improvements to engine house and probably to install Ball engines. H. M. Stanford is manager.

AVON PARK, FLA.—The Town Council has granted L. O. Feagin a franchise to construct and operate an electric-light plant and water-works system in Avon Park.

GULFPORT, FLA.—Application has been made to the City Council by F. J. Davenport and others for a franchise to install and operate electric-light, gas and water plants in Gulfport.

LAKELAND, FLA.—The city of Lakeland, it is reported, will vote on the proposal to issue $70,000 for additions to water and light plant, and $25,000 for extensions to distribution of light and water systems.

LEESBURG, FLA.—Rufus Vinsant, of Ashland, Ky.; Dr. Collier, of West Liberty,

Ky., and others are reported to have acquired Stone Mountain, and propose to erect a clubhouse, six residences, install water-works, electric-light plant, etc.

TAMPA, FLA.—The Tampa El. Co., it is reported, will install six boilers (equipped with automatic stokers) in the West Jackson Street power house and erect radial chimney 200 ft. high, at a cost of about $200,000.

WINTER HAVEN, FLA.—The Winter Haven Wtr., Ice & Lt. Co., it is reported, contemplates the installation of new machinery in its plant, including a 300-hp engine, two 6-in. pumps and extensions to its electric distributing lines and water mains. N. F. Boyd is manager.

HALLS, TENN.—Bids will be received by the city of Halls until June 1 for one 150-hp boiler, one 50-kva and one 75-kva generator, each to be directly connected to automatic high-speed engine, and installation of street-lighting system complete, including switchboard. R. C. Huston, Exchange Building, Memphis, Tenn., is consulting engineer. B. M. Archer is Mayor.

ASHFORD, ALA.—The proposal to issue $8,000 in bonds for the installation of a municipal electric-light plant will be submitted to the voters on June 8.

MONTGOMERY, ALA.—The Alabama Trac. Co. has applied to the City Commissioners for a 30-year franchise to construct and operate an electric street railway on certain streets of the city.

GREENVILLE, MISS.—The Delta Lt. & Trac. Co., recently organized, has acquired the property of the Delta El. Lt., Pwr. & Mfg. Co., of Greenville, operating electric-light plant and street railway (10 miles) and equipment; Riverside Transmission Co., operating transmission line from Greenville to Arkansas and Mississippi points; Chicot Lt. & Pwr. Co., furnishing electricity in Chicot County, Arkansas, and Lake Village Lt. & Pwr. Co., of Lake Village, Ark. The Delta Lt. & Trac. Co. contemplates improvements to the systems. Frank Robertshaw, of Greenville, is president; Ralph Claggett, secretary and general manager, and E. J. Lenz, superintendent, all of Greenville.

JONESBORO, ARK.—Arrangements are being made to rebuild the electric plant of the State Agricultural College, recently destroyed by fire. New equipment will be purchased consisting of two tubular bricked-in boilers (one 125-hp and one 120-hp), one 30-kw, 110-220-volt direct-current generator and engine or turbine, directly connected. Switchboard equipment will be purchased later. V. C. Kays, of Jonesboro, is engineer in charge.

DELHI, LA.—The town of Delhi has granted E. Scott, of Rayville, a franchise to construct an electric-light plant here.

MELVILLE, LA.—At an election held May 12 the proposal to issue bonds for the installation of a municipal electric-light plant was carried. Anderson Offut, 439 Carondelet Street, New Orleans, is consulting engineer.

NEW ORLEANS, LA.—Bids will be received at the office of the lighthouse inspector, New Orleans, until June 18 for furnishing and installing an electric plant for the completion of the tender *Camellia*. Blank proposals and particulars may be obtained by addressing light-house inspector at New Orleans.

JET, OKLA.—At an election held recently the proposal to install an electric-lighting system in Jet was carried.

WILBURTON, OKLA.—The City Council is considering the installation of municipal electric-lighting and water systems in Wilburton.

AUSTIN, TEX.—The Austin St. Ry. Co. is reported to be contemplating building an addition to its power house, at a cost of about $2,000.

PHARR, TEX.—The Pharr Ice, Lt. & Pwr. Co., recently organized with a capital stock of $40,000, it is reported, will erect an electric light and power plant and ice factory. S. R. Gathrop is one of the incorporators.

SANGER, TEX.—The installation of an electric-light plant is under consideration. C. P. Dodson is reported interested in the project.

Pacific States

KELSO, WASH.—The Kelso Wtr. Co., recently incorporated with a capital stock of $30,000, it is reported, will take over the plant of the Independent El. Co. The incorporators are: E. W. Hall, of Portland, Ore.; B. M. Atkins, of Kelso, and B. Yates, of Vancouver, Wash. The headquarters of the company will be in Vancouver.

LEAVENWORTH, WASH.—The Cashmere Wtr. Co., of Cashmere, has applied to the City Council for a franchise to distribute electricity for lamps and motors in Leavenworth. The company proposes to build a hydroelectric plant near Cashmere and supply energy to the entire Wenatchee Valley.

NORTH YAKIMA, WASH.—The Central Htg. Co. has petitioned the City Council for a franchise to furnish electricity for lamps and motors in addition to its heating service in North Yakima. If granted a franchise, the company proposes to build a plant, at a cost of $100,000.

RIDGEFIELD, WASH.—J. H. Cunningham, of Portland, Ore., has applied to the City Council for a franchise to furnish electricity and water in Ridgefield.

SEATTLE, WASH.—Plans prepared by Daniel Huntington, city architect, for the power station of the auxiliary steam plant on Lake Union, to cost $50,000, for the city lighting system, have been approved by the Board of Public Works. The plant complete will cost about $350,000.

SEATTLE, WASH.—The City Council has tentatively adopted the plan proposed by Mayor Gill to develop the Cedar River power project before steps are taken to acquire other power sites. It is proposed to raise the dam to an elevation of 1555 ft., increasing the output of the Cedar Falls plant from 9000 kw to 14,000 kw, while the completion of the first unit of the Lake Union Steam plant will add 7500 kw to the municipal electric system. J. D. Ross is superintendent of lighting.

SOUTH BEND, WASH.—Application has been filed with the County Commissioners by Frank McLean, vice-president and general manager of the Willapa Pwr. Co., recently incorporated, for a franchise for an electric railway and to furnish electricity in Pacific County. This is a part of the proposed development of the company's electric system on the south fork of the Willapa River and in South Bend. The headquarters of the company are in the White Building, Seattle.

DRAIN, ORE.—At an election held May 12 the proposal to issue bonds for the installation of an electric-light plant was carried.

GLENDALE, ORE.—The property of the Glendale Lt. & Pwr. Co. has been purchased by the California-Oregon Pwr. Co., of Medford. The latter company will erect a 12-mile transmission line from Placer to Glendale, for which contracts have been awarded. H. C. Stoddard, of Medford, is engineer in charge of the work.

SALEM, ORE.—Application has been filed with State Engineer Lewis by U. G. Hayne, of Portland, for a permit to build a 10,000-acre-ft. storage reservoir on Parmelia Lake, to be used for the development of 21,136 hp. Mr. Hayne also proposes to utilize the water of Marion River, Minto Creek, Parmelia Creek and White Water Creek.

BISHOP, CAL.—Arrangements are being made by the Nevada-California Pwr. Co. for financing for the hydroelectric plant to be built on Bishop Creek this year. It is expected to have the first 13,000-hp unit in operation in 1915.

PORTOLA, CAL.—The Supervisors of Plumas County have granted R. B. Young, of Loyalton, a franchise to construct and operate an electric-lighting system in Portola.

SAN FRANCISCO, CAL.—The directors of the Northern California Pwr. Co., of San Francisco have called a special meeting of the stockholders for July 17 to authorize an increase in capital stock of $2,000,000, of which $500,000 is to be issued and sold at once.

SALT LAKE CITY, UTAH.—Bids will be received by the State Capitol Commission, Salt Lake City, until June 5, for furnishing lighting fixtures or lighting systems, required for the entire Utah State Capitol Building, now being erected on the Capitol grounds. Plans are on file in the office of Richard Kletting, architect, 415 Felt Building, Salt Lake City, Utah.

GREEN RIVER, UTAH.—A special election will soon be called to vote on the proposal to issue bonds for the purpose of establishing a municipal electric-light plant in Green River.

FLORENCE, ARIZ.—The City Council has instructed the city engineer to make investigations as to necessary legal steps to be taken by the city to raise funds for the establishment of a municipal electric-light plant.

LEWISTOWN, MONT.—The City Council has awarded the contract for furnishing material and installation of a special lighting system in the business district to the Veley Construction Co., of Livingston, at $15,000.

GREELEY, COL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 30, for construction complete, including mechanical equipment, lighting fixtures and approaches, of the United States post office building at Greeley. Drawings and specifications may be obtained from the above office or from the custodian of site at Greeley. O Wenderoth is supervising architect.

PLATTEVILLE, COL.—H. Woodward, who is erecting an alfalfa mill in Platteville, it is reported, has applied for a franchise to furnish electricity for lamps here.

Canada

KELOWNA, B. C.—Tenders will be received by G. H. Dunn, city clerk, until June 11 for furnishing the following apparatus, f.o.b. on cars Kelowna: One 225-hp vertical, two-crank, compound steam engine, one feed-water heater, one independent air pump and jet condenser, one 150-kw, three-phase, 60-cycle, 2200-volt generator for direct connection to engine, exciter for direct connection to generator, one switchboard panel to match present switchboard. Specifications may be obtained from the consulting engineer's branch office at Vernon, B. C. C. R. Yuill, successor to Mather, Yuill & Co., of Vancouver, is consulting engineer.

WINNIPEG, MAN.—Bids will be received by the City Light and Power Department of Winnipeg until June 12 for furnishing and installing approximately 5500 ft. of three-core, paper-insulated, lead-covered, 13,000-volt cable. Specifications are on file in the office of J. G. Glassco, engineer, 54 King street, Winnipeg.

ESSEX, ONT.—The Town Council is considering the question of installing a generator, motor and pump, and also laying mains to connect Garrow well with the town system.

STRATFORD, ONT.—The by-law appropriating $22,000 for an ornamental street-lighting system on the two main streets and for extensions and improvements to the present street-lighting system has been approved by the ratepayers.

MOOSE JAW, SASK.—The by-law providing for an expenditure of $155,000 for electric-lighting was approved by the ratepayers at an election held recently.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, Panama Canal, Washington, D. C., until June 11, for material for oil-handling plants, including pumps, headers, valves, pipe and fittings; centrifugal pump unit, complete with motor, automatic starting apparatus, float switch, etc.; altitude gages, compound gage, paving brick and tiles. Blanks and general information relating to this circular (No. 854) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C Boggs is general purchasing officer.

New Incorporations

MONTEZUMA, GA.—The Montezuma Lt. & Pwr. Co. has been incorporated with a capital stock of $20,000 by E. B. Lewis, W. H. McKenzie and J. W. McKenzie. The company, it is understood, will take over the property of the Montezuma Mfg. Co.

BLACKFOOT, IDAHO.—The Bingham County Pwr. Co. has been incorporated with a capital stock of $50,000 by J. M. Stevens, J. T. Carruth and W. R. Jones, all of Blackfoot. The company owns several power sites on Wolverine Creek, which, it is understood, will be developed.

MARS HILL, MAINE.—The Westfield El. Co. has been organized with a capital stock of $5,000 for the purpose of generating and distributing electricity. The officers are Royal J. Colbath, of Westfield, president, and Aubrey C. Frost, of Limestone, treasurer.

NASHVILLE, TENN.—The Tennessee Trac. & Lt. Co. has been incorporated with a capital stock of $10,000 by R. G. Sparrow, S. E. Goodwin, W. H. Parrish, Jr., C. H. Smith and J. N. Vaughn.

GOWGANDA, ONT., CAN.—The Gowganda Pwr. Co. has been incorporated with a capital stock of $100,000 by J. G. Shaw, J. Montgomery and H. P. Edge.

SOREL, QUE., CAN.—The General Utilities Corporation has been chartered with a capital stock of $50,000 and the following directors: A. E. Pontbriand, J. A. Simiard and A. Peticlere, of Sorel, Que., and G. E. Pontbriand, Shawinigan Falls, Que.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 19, 1914.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,096,820. ELECTRIC HEATING UNIT; H. P. Ball, Pittsfield, Mass. App. filed Dec. 21, 1912. Resistance unit compressed in recess in supporting plate.

1,096,839. INSULATING MATERIAL; J. L. R. Hayden, Schenectady, N. Y. App. filed Sept. 20, 1909. Contains phenolic condensation product and paraffin oil dissolved in mixture of alcohol and amylacetate.

1,096,840. SQUIRREL-CAGE WINDING FOR INDUCTION MOTORS; T. Hoock, Wilkinsburg, Pa. App. filed June 6, 1911. Made up of sheet-metal grids, the bars of which fit in the slots.

1,096,841. CALLING DEVICE; W. Kaisling, Chicago, Ill. App. filed July 9, 1910. For automatic and semi-automatic telephone systems.

1,096,859. ELECTRIC INCANDESCENT LAMP; J. E. Putter, St. Joseph, Mo. App. filed June 18, 1912. Tungsten lamps with center supporting post formed with reflecting surfaces disposed in back of the filaments.

1,096,879. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Philadelphia, Pa. App. filed March 23, 1911. Mechanically connected armatures serving for dynamo and motor purposes when charging battery and starting engine.

1,096,908. HEATER; W. S. Hadaway, Jr., New Rochelle, N. Y. App. filed March 11, 1913. Stocking mold with steam tubes therein and electric element imparting heat thereto.

1,096,913. PULL-BUTTON CONTROLLING SWITCH; C. H. Hill, Schenectady, N. Y. App. filed May 17, 1906. The pull-knobs only project from the switchboard-interlocking system.

1,096,915. THERMOSTATIC CUT-OUT FOR ELECTRIC CIRCUITS; W. F. Hoffman, Detroit, Mich. App. filed June 18, 1912. For warming-pads.

1,096,916. ELECTRICALLY HEATED WARMING-PAD; W. F. Hoffman, Detroit, Mich. App. filed July 2, 1912. Flexible pad with plurality of thermostatic controllers.

1,096,922. METHOD OF AND APPARATUS FOR STARTING ALTERNATING-CURRENT MOTORS; M. Korndörfer, Pankow, Germany. App. filed May 15, 1908. Starting compensator becomes a reactive coil in series between the feeder line and motor terminals.

1,096,923. CONVERTER; C. Kramer, Frankfort-on-the-Main, Germany. App. filed Nov. 22, 1909. Motor-generator with motor connected to constant potential supply circuit and generator permanently connected with constant-current working circuit.

1,096,926. ELECTRICALLY HEATED SADIRON; F. Kuhn, Detroit, Mich. App. filed Feb. 25, 1911. Thin, flat heating element arranged between work body and heat-distributing member of considerably greater thickness.

1,096,927. LUMINOUS ELECTRIC HEATER; F. Kuhn, Detroit, Mich. App. filed May 18, 1911. Adapted to be employed as substitute for fireplace.

1,096,928. ELECTRIC HEATER; F. Kuhn, Detroit, Mich. App. filed March 29, 1912. Heating element damped in heat-conducting contact with all portions of the "hot-plate" without marring or interrupting the surface of the same.

1,096,929. ELECTRICALLY HEATED SADIRON; F. Kuhn, Detroit, Mich. App. filed Oct. 5, 1912. Screw forms a common clamping means for the insulating terminal support, the heat-distributing plate, heating element and base plate.

1,096,930. LOAD-DISTRIBUTING APPARATUS; H. A. Laycock, Schenectady, N. Y. App. filed Oct. 2, 1912. For automatically securing proper load distribution upon two dynamo-electric machines connected in parallel.

1,096,934. AUTOMATIC CURRENT CONTROLLER; H. Meredith-Jones, New York, N. Y. App. filed March 26, 1913. For insuring uniform current for the secondary work performed by the prime mover irrespective of fluctuations in amount of primary work performed thereby.

1,097,002. SELECTING MECHANISM; A. E. Case, Chicago, Ill. App. filed Dec. 19, 1910. For multi-party telephone lines. (Eighty-six claims.)

1,097,005. TEMPERATURE REGULATOR; W. B. Dahl, Minneapolis, Minn. App. filed May 26, 1913. Contact terminal plate affixed to wall and the thermostat casing has contacts engaging the same.

1,097,022. PORTABLE ELECTRIC-LIGHTING APPARATUS; H. H. Hirsch, Philadelphia, Pa. App. filed May 29, 1913. Miner's lamp with means for extinguishing lamp when the casing is subjected to stresses tending to break the lamp.

1,097,053. PEDAL-CONTROLLED RHEOSTAT FOR MUSICAL INSTRUMENTS; M. L. Severy, Arlington Heights, and G. B. Sinclair, Winthrop, Mass. App. filed Aug. 7, 1905. For varying the resistance of all the magnet circuits simultaneously.

1,097,062. VAPOR RECTIFIER SYSTEM; C. P. Steinmetz, Schenectady, N. Y. App. filed Sept. 25, 1905. For exciting the rectifiers to maintain them continuously conductive for current from the source.

1,097,080. RAILWAY SIGNALING SYSTEM; C. J. Coleman, New York, N. Y. App. filed July 24, 1906. Rail circuits for home-and-distant block signals.

1,097,116. CIRCUIT-EXTENSION BOX; C. W. Abbott, Auburn, N. Y. App. filed Feb. 8, 1913. By which a circuit may be picked up and extended from a "flush switch."

1,097,136. ELECTRICAL SYSTEM FOR TRANSFERRING CARS; T. F. Mullaney, New York, N. Y. App. filed Feb. 26, 1909. Movement of transfer car controls current in the parallel incoming or storage tracks.

1,097,137. ELECTRICAL SYSTEM FOR TRANSFERRING CARS; T. F. Mullaney, New York, N. Y. App. filed Feb. 26, 1909. For charging the various tracks.

1,097,160. RAILWAY SYSTEM. C. E. Balzer, McKee's Rocks, Pa. App. filed April 24, 1913. Toy or carrier system with block signals preventing cars from running into each other.

1,097,161. CLUTCH; J. T. Beechlyn, Lynn, Mass. App. filed July 17, 1911. Special construction for arc-lamp electrodes.

1,097,175. REGULATING ELECTRIC-ARC LAMPS; R. Friese, Charlottenburg, Germany. App. filed July 15, 1913. Varying intensity for stage illumination.

1,097,197. RAILWAY SIGNALING SYSTEM; J. C. Thullen, Leetonia, Ohio, and L. H. Thullen, Edgewood Park, Pa. App. filed Sept. 10, 1903. Signals operated by alternating current of more than one phase, and both rails utilized as return for propulsion current.

1,097,207. ELECTRIC PULL SWITCH; F. Barr, New York, N. Y. App. filed Oct. 24, 1912. Wall-box type.

1,097,208. ELECTRIC SWITCH; F. Barr, New York, N. Y. App. filed Dec. 12, 1912. Lamp-cluster pull switch.

1,097,209. ELECTRIC SWITCH; F. Barr, New York, N. Y. App. filed Dec. 16, 1910. Rosette type of pull switch.

1,097,210. ELECTRIC SWITCH; F. Barr, New York, N. Y. App. filed Jan. 16, 1913. Wall-box three-way pull switch.

1,097,220. CONNECTING PLUG; O. M. Glunt, Rutherford, N. J. App. filed April 21, 1913. Jack plug with special terminal construction.

1,097,223. HEATING AND REGULATING APPARATUS; W. S. Hadaway, Jr., New Rochelle, N. Y. App. filed Feb. 20, 1913. Matrix drying press.

1,097,227. ELECTRODE FOR ELECTRIC FURNACES; A. T. Hinckley, Niagara Falls, N. Y. App. filed Feb. 5, 1912. Special end-to-end joint for electrodes.

1,097,232. CURRENT-DISCHARGE-DISTRIBUTING SYSTEM; J. P. Juley, Jersey City, N. J. App. filed Nov. 11, 1913. For large telegraph offices, etc.

1,097,241. SIDING PROTECTION FOR SIGNALING SYSTEMS; W. H. Lane and C. W. Coleman, Westfield, N. J. App. filed July 6, 1908. Arranged so that failure in the siding apparatus or the side track is a safe failure to the same extent as a corresponding failure in the main line.

1,097,250. CONDUIT CONTACT PLOW FOR ELECTRIC RAILWAYS; J. S. McWhirter, New York, N. Y. App. filed Jan. 21, 1913. To permit ready replacement of the contact shoe.

1,097,256. CIRCUIT-BREAKER; E. J. Murphy, Schenectady, N. Y. App. filed Feb. 2, 1912. Overload or underload.

1,097,289. CABLE SPLICE; F. N. Bierce, Cincinnati, Ohio. App. filed April 17, 1912. Seal for the spliced ends.

1,097,291. COIL-SUPPORTING POST FOR ELECTRICAL WATER HEATERS; R. A. Bower, San Francisco, Cal. App. filed Feb. 9, 1914. Constructed to prevent leakage from the water chamber into the switch chamber.

1,097,292. FAUCET LEVER FOR ELECTRICAL WATER HEATERS; R. A. Bower, San Francisco, Cal. App. filed Feb. 9, 1914. Special means to prevent the faucet lever or switch from working loose from the valve stem.

1,097,293. FAUCET BRACKET FOR ELECTRICAL WATER HEATERS; R. A. Bower, San Francisco, Cal. App. filed Feb. 9, 1914. For pantry or kitchen use.

1,097,294. AUTOMATIC FUSE PLUG; L. M. Bowman, Fort Worth, Tex. App. filed Aug. 26, 1913. Plurality of fuse wires arranged to be successively engaged by a swinging contact arm.

1,097,307. TELEPHONE SYSTEM; A. H. Dyson, Chicago, Ill. App. filed Dec. 4, 1906. Automatic or semi-automatic type. (Eighty-six claims.)

1,097,320. METHOD OF ELECTRICAL TRANSMISSION; P. C. Hewitt, New York, N. Y. App. filed Oct. 30, 1912. Mercury-vapor rectifier.

1,097,321. SINGLE-PHASE DIRECTIONAL CURRENT ARRESTER; P. C. Hewitt, New York, N. Y. App. filed Oct. 30, 1912. Single-phase or ordinary two-phase vapor rectifier.

1,097,336. ELECTRIC FURNACE WORKING WITH AN ELECTRIC ARC OR ARCS FOR MELTING AND EXTRACTION OF METAL FROM ORE; P. Krefting, Christiania, Norway. App. filed April 3, 1911. For maintaining predetermined temperature in the melting chamber and insuring regular supply of the charge.

1,097,344. SIGNAL APPARATUS FOR ELEVATORS; J. F. McCarthy, Philadelphia, Pa. App. filed June 13, 1912. Dial system operates the up-and-down signal lights.

1,097,348. TEMPERATURE INDICATOR; E. R. Murray, Alameda, Cal. App. filed May 12, 1913. Mercury in tube closes circuits through indicator magnets.

1,097,358. CONTROLLING MECHANISM FOR ELECTRICAL VEHICLES; F. G. Peck, Buffalo, N. Y. App. filed Oct. 16, 1909. Foot pedal controls speed or applies brakes.

1,097,359. DESK TELEPHONE; N. Pedersen, Genoa, Ill. App. filed Jan. 24, 1911. Special circuit charging springs.

1,097,360. MOTOR; G. E. Perry, Chicago, Ill. App. filed Oct. 25, 1909. Self-winding clock motor.

1,097,392. BATTERY BOX SUPPORT AND INSULATOR; A. C. Cremer and G. F. Molander, Baltimore, Md. App. filed July 29, 1913. To prevent short-circuiting in case of slopping or foaming over of the acid.

1,097,400. ELECTROMAGNET; A. F. Dixon, Newark, N. J. App. filed Dec. 18, 1912. Easy and positive armature adjustment for telephone signal bells.

1,097,414. ADJUSTABLE INSULATOR SUPPORT; L. Fort, Jersey City, N. J. App. filed Feb. 6, 1913. Adjustments for cross-arms of various cross-sections.

1,097,428. CONTROLLER FOR ELECTRIC MOTORS; J. H. Hall, Cleveland, Ohio. App. filed Dec. 13, 1912. For alternating-current motors where transformer or voltage-reducing device is used in starting.

1,097,438. INDICATING FUSE HOLDER; B. D. Horton, Detroit, Mich. App. filed Jan. 7, 1914. Special fuse terminals and external indicator.

1,097,473. VAPOR ELECTRIC APPARATUS; B. Schaefer, Frankfort-on-the-Main, Germany. App. filed Feb. 25, 1913. Means for condensing metal vapors rising from cathode.

1,097,540. SELECTIVE SWITCHING APPARATUS; A. F. Dixon, Newark, N. J. App. filed Aug. 10, 1912. For telephone systems of automatic or semi-automatic type.

1,097,547. DIRECTIONAL CURRENT ARRESTER; P. C. Hewitt, New York, N. Y. App. filed Oct. 30, 1902. Exhausted envelope, multiphase electrodes and supplemental means for continuously generating ionized vapor in the envelope.

1,097,552. GAS-TIGHT MECHANICAL SEAL; C. Kramer, Berlin, Germany. App. filed Aug. 28, 1913. For mercury-vapor devices.

1,097,587. MEANS FOR VAULT PROTECTION; W. D. Hammond, Los Angeles, Cal. App. filed March 27, 1912. Walls of vault cannot be cut into without affecting the electrical circuit.

1,097,602. COUPLING FOR ELECTRICAL CONDUCTORS; W. L. Bliss, Milwaukee, Wis. App. filed May 9, 1907. Between cars of an electrical train-lighting system.